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ACADEMIC FREEDOM AND THE STATE

IN the present international situation the question of intellectual freedom has more than academic interest in Great Britain and elsewhere, and one consequence of recent incidents is bound to be the voicing of fresh concern as to whether the provisions of the Official Secrets Act are adequate by themselves, and whether the measures put into force in accordance with the Prime Minister's announcement of March 15, 1948, have been pursued with sufficient vigour. As a contribution to more objective thinking on the whole issue, the publication in a recent issue of the *Proceedings of the American Philosophical Society* of the paper on "Changing Issues in Academic Freedom in the United States To-day"*, which Mr. H. O. Gideonse read at the autumn general meeting of the Society, will be welcomed by all who hold their freedom sacred. Under present conditions, proceedings in this field in the United States are of real interest in Great Britain, when all allowance is made for differing political conditions, and it is important that there should be a clear understanding of what is the position in the United States. Such an understanding in itself will contribute to the formation of standards of judgment which will prevent hasty or ill-considered action likely to be detrimental either to the advance of science or to the welfare of the State.

Mr. Gideonse addresses himself to three aspects of the problem of academic freedom, all of which have their counterpart in Great Britain, but only the first of which—teachers who accept political discipline in matters of science and scientific opinion—is related to the purging of the Civil Service announced by the Prime Minister two years ago. The impact on scholarly activities of United States Federal security regulations, especially in the field of the physical sciences, presents an exact parallel to a problem that has been troubling the Atomic Scientists' Association and others also in Britain, and the changing sources of academic financial support represent a problem that in Britain has already attracted the attention of the University Grants Committee, the Nuffield Foundation and of other bodies which are endowing research or higher educational activities.

On the first question, Mr. Gideonse gives a clear statement of the position in the United States and of the underlying issues. Together with the statements forming the first five chapters in the "Primer of Intellectual Freedom", edited by Prof. H. M. Jones for the Harvard University Press†, they permit an independent opinion to be formed on the situation in the United States and on the action taken by the universities. The first and most encouraging impression that emerges is the essential soundness of the position taken up by the American universities, and their clear grasp of what is at stake and what needs to be defended.

* *Proceedings of the American Philosophical Society*, **94**, No. 2: Intellectual Freedom and other Papers read at the Autumn General Meeting of the Society, November 4–5, 1949. Pp. 89–184. (Philadelphia: American Philosophical Society, 1950.) 1 dollar.

† Primer of Intellectual Freedom. Edited by Howard Mumford Jones. Pp. xv+191. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1949.) 22*s.* net.

Mr. Gideonse recognizes that the function of a university is the discovery and the dissemination of the truth in all branches of learning, and that, as such, the freedom of the academic teacher is essential to the preservation of free society itself. As a social tradition, he adds, academic freedom is morally anchored in this dedication to truth. This is little more than a paraphrase of Prof. Z. Chafee's assertion thirty years ago in a famous essay, since expanded into his book "Free Speech in the United States", quoted in the "Primer of Intellectual Freedom", that the true meaning of freedom of speech seems to be that one of the most important purposes of society and government is the discovery and spread of truth on subjects of general concern.

This is to argue that the safeguarding of academic or intellectual freedom is a social need and responsibility, and not merely the need and duty of the individual. To accept this point of view, however, only emphasizes all that Dr. J. B. Conant and Sir Walter Moberly, for example, have said as to the importance of respecting and maintaining the unique criteria for joining a community of scholars. Such a community cannot ask for its freedom to be safeguarded as a condition for the maintenance of its standards while it admits or harbours those who repudiate its standards and give their primary loyalties elsewhere.

"Granted honesty, sincerity and ability", wrote Dr. Conant, "there must be tolerance of a wide diversity of opinion." "Any teacher who is not against intellectual dishonesty", wrote Sir Walter Moberly, "is out of place in the university. The corollary of freedom is responsibility. For the university, some kind of effective self-criticism is the only alternative to forcible interference from outside." This issue of responsibility is hammered home by Mr. Gideonse in a way which leaves no moral prerequisites for freedom taken for granted, and makes no attempt to conceal the way in which certain action on students' activities by the Committee on Academic Freedom of the American Civil Liberties' Union completely disregarded the moral basis of our liberties.

This first part of Mr. Gideonse's paper puts the real issue of intellectual honesty and responsibility as the first condition of academic freedom in its rightful place; and he exposes the spuriousness of some of the claims for independent judgment which are made in a totalitarian society. The soundness of his appeal to the true and classic tradition is amply demonstrated by those papers of Karl Pearson on the scope and method of science, of Bagehot on the metaphysical basis of toleration, of Morley on intellectual responsibility, of Mill on liberty, Jefferson's first inaugural address, Milton's "Areopagitica", and the quotation from Bacon's "Advancement of Learning", all of which have been collected in the "Primer of Intellectual Freedom". Bagehot may well have the most pertinent word with his reminder that no government is bound to permit a controversy which will annihilate itself, and that toleration presupposes a state of society in which discussion is possible.

With Mr. Gideonse's endorsement of the by-law of the New School for Social Research, which states that "no member of the faculty may be a member of any political party or group which presumes to dictate in matters of science or scientific opinion", as a courageous and realistic translation in twentieth-century terms of the essential content of the classical ideal of academic freedom, we may pass to his consideration of academic freedom and federal security regulations. Here also he pleads for an understanding of the cultural conditions in which science can flourish, and of the dangers, against which Morley warned an earlier generation, of tampering with veracity, from any motive, or turning the edge of reason. A wide public conception of the extent to which continuous achievement in science depends upon a constant and open process of interplay of ideas, experiments and discussions is the first step to the formulation of security measures and procedures, whether in Great Britain, the United States or elsewhere. We must, indeed, have regard to the plain fact that, in certain fields which bear vitally on problems of national defence, the interplay of ideas and exchange of knowledge across national frontiers, which as Mr. Gideonse correctly notes have proved so fruitful in the past, have been interdicted by one important nation and her satellites. The free nations cannot ignore that danger; but no one has yet indicated what can be done to repair the loss.

Plainly as we must recognize that to attempt to continue a traffic in the one direction only would endanger security without benefiting science, it has still to be remembered that, if a nation is to secure in the service of its Government the ablest men of science, the conditions of service must be such as to attract first-rate men and nurture their creative powers. Dr. Conant and others have been right to urge that national security ultimately depends on our ability to preserve the conditions which have attracted such men in the past and will enable Great Britain and the United States to maintain their leadership and eminence in science. Mr. Gideonse puts this issue clearly; but there is nevertheless a clash, and he gives no indication as to where or how the balance is to be struck between the short-term and the long-term needs of national security—between effective safeguards against the disclosure of military secrets, and the maintenance of the open interchange of thought and results upon which the advance of science depends.

On the third issue, that of the changes of sources of financial support for academic activities, Mr. Gideonse notes, as others have done, that the shrinking bases of private financial support, whether in fees or in endowment, and the increasing share of government agencies in financial responsibility, have brought new dangers to free scholarship. There is an increased risk that some of the best of our creative talent may devote their most fruitful years to work selected by government agencies rather than by scholars themselves, and there are corresponding hazards to qualitative standards elsewhere. Moreover, the vigorous promotion by government grants of research in the physical and biological sciences, and

concurrently of the training of staff for expansion in these fields, may widen the gap that already threatens the stability of society, between scientific and technical change on one hand, and the relative inflexibility of the moral, social and legal framework of society, on the other.

More extensive study of techniques of social adjustment, including an imaginative and constructive programme in the humanities, might well help to increase the stability of society; but, as Mr. Gideonse points out, legislators find it very hard to distinguish between the study of social change and the advocacy of social change. If the State is to be increasingly responsible for the financial support of physical and biological research, academic groups will carry a special responsibility for seeing that social and humanistic studies do not shrink to proportions that will themselves constitute a major hazard to the future of free society, and thereby to the freedom even of the physical scientist.

Freedom, in the view of Mr. Gideonse, is first of all availability of choice, and the survival of freedom calls for an intellectual understanding of the choice, as well as the development of a will to choose. A free community emerges whenever internal checks can be substituted for external constraint; and, conversely, freedom is endangered if in a free community shared values are no longer sufficiently vigorous to create the moral cohesion on which the discipline of free men rests. Mr. Gideonse's paper is not merely an interpretation of American thought on this issue; it is also a challenge to further constructive thought on the problem everywhere; and with the challenge, his paper provides material for such thinking which is no less stimulating than those classic essays which Prof. Jones has collected alongside of modern material in his "Primer of Intellectual Freedom". No one who reads and thinks over these papers can remain in much doubt that, on one hand, this is an issue which vitally affects the welfare of society as well as the advance of science, or that, on the other hand, it is not simply an issue of freedom but equally one of intellectual honesty and of loyalty to the strict discipline of professional ideals and traditions.

SIR ARTHUR KEITH, F.R.S.

An Autobiography

By Sir Arthur Keith. Pp. vii+721+6 plates. (London: C. A. Watts and Co., 1950.) 25*s*.

THE export of young people from Scotland and Wales, and, in the case of Scotland, very notably from the Aberdeen region, is one of the means whereby the higher initiatives are maintained in British life. Frugal homes, hard work, courage to face difficulties and a strong spice of ambition are important factors; and most of these are expressions of what Bergson so aptly called *élan vital*. The names that come into the early pages of this book amply confirm established beliefs about Aberdeen's value to our common life. One need but say, by way of illustration, that Sir Arthur Keith and Sir Leslie Mackenzie were class-fellows in the faculty of medicine, at the University of Aberdeen. Sir Arthur's friends well remember their anxiety for him more than twenty years ago, when it was feared that pulmonary tuberculosis and other troubles were bringing him down, and Lady Keith was trying to nurse him. Yet, he has now survived her by fifteen years, and this book, written when he was already over eighty, is full of zest.

To the Aberdonian qualities above-named should be added that of mutual aid and the loyalty which accompanies it. Keith's grateful acknowledgments to James Trail, professor of botany at Aberdeen, are a pleasing illustration here.

Keith was early impressed with the importance of Darwin's contribution to thought about man. Evolution in the Darwinian sense, but, as time went on, with the additions made by the geneticists, was to be the keynote of a refreshed view of social problems so often befogged by wishful thinking. To Keith there seems to be no evidence for the existence of mind, or so-called spirit, apart from its physical basis, and he has long worked for the Rationalist group, of which his friend Mr. Charles Watts, the publisher, was the centre as long as he lived. This brought Keith into many controversies; but we must note that he kept a very affectionate regard for Sir William and Lady Bragg, who took a very different view, and he liked and enjoyed discussion with H. G. Wells, who also differed deeply in quite another way. Keith thought of nationalism as part of the evolutionary process; Wells saw it as an obstacle to the universalism for which he strove. Keith's exposition of nationalism in evolution has often been taken, largely mistaken, for a glorification of war. Perhaps the author's perennial difficulty in finding just the expression he wants is partly accountable here. The story is told of the rise from primal poverty and struggle to a position, not of affluence but of influence, as one of the men who stood for science in the public eye and, at the same time, tried to contribute, himself, to the advancement of natural knowledge, especially in anatomy. He has been an interpreter, perhaps, in the main; and it is often difficult to put one's finger on a particular part of an interpreter's work and say this is his great personal contribution. But one may say without reserve that Keith has been a major contributor to the study of human evolution. His early belief in the high antiquity of our race became dim as the Galley Hill skeleton came to be assigned to later post-Pleistocene periods; but one hopes he may yet tell us how he reacts to Dr. K. P. Oakley's interesting work tending to show that the Swanscombe bones, probably nearer *Homo sapiens* than Piltdown is, are so much more ancient than the latter.

Sir Arthur made the Museum of the Royal College of Surgeons a famous centre of scientific discussion; with his friend, Sir Buckston Browne, built up the Surgical Research Centre at Downe; and, in addition to all this, he spoke for science to the general public in Britain and America.

The autobiography is a long series of glimpses, some of which we should have liked to have in more expanded form. He makes little attempt to hide or excuse what he considers his mistakes or faults, not even in famous discussions with Elliot Smith, to whose ability he pays generous tribute. His more intimate personal relations are discussed with considerable frankness, and we have a picture of an indefatigable worker full of his deep belief in Darwinian principles, and ambitious to play the part of their interpreter to his generation of students

of man. There is something peculiarly appropriate in the fact that Sir Arthur has spent his years of retirement within sight of Darwin's old home, which he helped to dedicate as a public trust in memory of the great naturalist.

MONOGRAPH ON THE LARYNX

The Comparative Anatomy and Physiology of the Larynx

By V. E. Negus. Pp. xix+230. (London: William Heinemann Medical Books, Ltd., 1949.) 30*s*. net.

MR. V. E. NEGUS has enriched a masterly condensation and re-arrangement of his book, "The Mechanism of the Larynx", by further observation and original thought during the past twenty years in order to produce the present work. The evolution of the larynx is traced from its earliest appearance, and a critical assessment of its anatomical modifications is correlated with the habits and physiological requirements of the animal.

Laryngeal modifications associated with the prevention of entry of fluid or foodstuffs into the lungs are discussed relative to the position of the larynx and the presence of lateral food channels. The calibre of the air passages, the variations in the form of the laryngeal cartilages and the influence of an inlet valve at the glottis are judged according to the habits of the animals, including the free use of the forelimbs. Emphasis is directed to the importance of air sacs, whether buccal, laryngeal, thoracic or abdominal in position, as they function in the rebreathing of air by an internal mechanism of respiration. Sound production as a means of communication necessitated by the normal habits of animals is studied by an extensive survey of comparative anatomical material, and the relationship of sound production to the sense of hearing is fully discussed. The author accounts for all the characteristics of the human larynx by reasons other than phonation, showing, however, that the larynx of man proves to be a tool equal to the demands of his intelligence.

A chapter on the "Anatomy of the Human Larynx" describes its regional anatomy in detail, and includes sections on its prenatal and postnatal growth and position. "Observations on the Evolution of Man from the Evidence of the Larynx" provides a stimulating topic for Appendix 1, which relates human evolution to laryngeal morphology and details the degenerations and altered position of the larynx associated with the adoption of an erect posture. The progressive reduction in the powers of olfaction and exercise tolerance is seen to be compensated by increased cerebral development.

Appendix 2 discusses the general adaptability and evolution of those structures which are utilized in sound production. The resonators, the separation of the epiglottis from the soft palate and the general structure of the oral cavity are all subjects for comment. Evidence presented suggests that early man was provided with a larynx as efficient as modern man but lacked the intelligence to use it. The author is convinced of the truth of Semon's Law and in Appendix 3 discusses critically the relevant factors in the evolution of the sphincteric and dilator muscles of the larynx.

The method of arrangement and production of this book is excellent. The illustrations are profuse in number, beautifully reproduced and include outlines of animals studied, as well as regional dissections carried out by the author. Many of the specimens from which illustrations are drawn are housed in the Royal College of Surgeons' Museum, the number given to the illustration in the book corresponding for ease of reference to the number in the collection.

A foreword is written by Sir Arthur Keith, and a list of chapters and headings is reinforced by a list of illustrations arranged under chapter headings, as well as a general index and an index of illustrations arranged alphabetically. The author explains the absence of a bibliography as an attempt to curtail the size of the book; the eleven chapters and three appendixes each possesses a summary of conclusions helpful to the reader. Those interested in the larynx, either as a subject for research and teaching or from a clinical point of view, will benefit by the wealth of information contained in this book.

C. HOWARD TONGE

SOME STUDIES OF BACTERIAL MORPHOLOGY

The Cytology and Life-History of Bacteria

By Dr. K. A. Bisset. Pp. xii+136. (Edinburgh: E. and S. Livingstone, Ltd., 1950.) 18*s*. 6*d*. net.

AN increasing interest, particularly over the past few years, has been directed to the fundamentals of bacterial structure and behaviour. In this short monograph, much of the work already published is reviewed, and Dr. K. A. Bisset describes the results of his own studies and discusses their interpretation.

While orthodox methods of staining dried preparations are of considerable value in applied bacteriology, they are firmly criticized here because they obscure delicate internal structure and may often produce artefacts. A number of special techniques for the demonstration of chromatinic material or of cell walls and other surface components is given; of these, the author finds most informative the acid-Giemsa method of Robinow and makes extensive use of tannic acid-violet staining and of colony imprint preparations. It is disappointing that the possibilities of the phase-contrast microscope could not be explored here; brief reference is made to the value of this method and to the more limited applications of electron and ultra-violet microscopy.

Chromatinic and other structures have been examined in many forms of bacteria at different phases of growth and multiplication, and it is possible to define two main types of fission—that of unicellular smooth organisms and that of rough forms which possess four cells. The same refinements of technique are used for demonstrating stages in the formation of spores, microcysts or resting cells. The more controversial aspects of the subject are discussed in a section on the nature of the bacterial chromosome and in later chapters which deal with sexuality, life-cycles and macroformations.

The interpretation of observations of this sort on fixed and stained preparations is often far from easy, and it seems likely that the use and further development of techniques for examining living bacteria are likely to prove of great value in resolving some of these problems. It is significant, for example, that Klieneberger-Nobel has only recently accepted that

the L forms of certain bacteria represent a gonidial phase and are not symbionts, as prolonged and careful study had indicated.

Any suggestion for simplifying the classification of bacteria is likely to prove attractive; how far this is possible along the proposed lines of structure and life-history would seem to depend on the regularity of these strictly morphological criteria, and limits of variation might well require more exact definition than is at present possible. In conclusion, Dr. Bisset makes a plea for correlating genetical with cytological studies, and claims that such genetic evidence as there is supports his own findings and their interpretation. The main thesis, that bacteria possess essentially the same complexity of structure and function as other cells, is carefully elaborated in the text and is beautifully illustrated by many line drawings and striking photographs.

C. F. BARWELL

FERTILITY AND STERILITY IN MAN

Human Fertility and Problems of the Male

By Dr. Edmond J. Farris. Pp. xvi+211+10 plates. (White Plains, N.Y.: The Author's Press, Inc., 1950.) n.p.

THE author, who is an executive director of the Wistar Institute of Anatomy and Biology in Philadelphia, designed this book for the use of physicians and scientifically minded laymen alike. The material, however, has been derived almost exclusively from the author's own researches, and consequently the reader should not expect to find in the book either general information or an appreciation of the whole problem of human sterility in all its manifold aspects. He will be confronted instead with an account of studies carried out by the author and his associates during the past decade, chiefly on the causes and alleviation of sterility in the human male.

In agreement with other workers in this field, the author comes to the serious conclusion that a large percentage of husbands in America suffer from various degrees of subfertility which in many, though by no means in all cases, is associated with abnormal composition of semen as assessed by microscopic examination of spermatozoa. The principles underlying the microscopic analysis of semen constitute the major theme of the book, and the author emphasizes particularly the point that an estimate of the total number of *motile* spermatozoa in an ejaculate offers a much better criterion of semen quality than a simple determination of sperm density, that is, the number of sperm, regardless of their motility, per ml. semen. It is reassuring to know that this principle is being applied by the author to the numerous cases which come under his observation. In Great Britain the principle of 'percentage motility' and 'degree of motility' has long been recognized as indispensable in the veterinary practice of semen analysis, and, thanks to the studies of Clare Harvey and Margaret Jackson, it is now applied in the examination of human semen as a routine.

On the point of preserving human sperm at low temperature, the author's experience has been rather discouraging; but then his methods vary considerably from those recommended by Parkes and others as absolutely essential for the survival of vitrified human spermatozoa. There is no mention in the book of either the biochemical or the physicochemical aspects of human semen. However, one has to bear in mind that the modern chemical and physical methods of semen analysis are relatively new and based upon the use of animal semen. It is very much to be hoped that the next decade will offer ample opportunity to the clinical investigator to apply to human semen some at least of the modern methods developed by research workers in the more advanced and wider field of fertility and sterility in animals.

T. MANN

HEALTH EDUCATION AND THE ADOLESCENT

Fundamentals of Health and Safety

By Grover W. Mueller and Dr. Elizabeth Chant Robertson. Pp. ix+345. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1948.) 14*s*. net.

THIS is an excellent book, the purpose of which is to give the adolescent a broad understanding of how his body is made and how it works, what forces are acting upon him, how to get on with other people, what the community is doing to promote health and prevent disease, and what he himself must do to promote his own health and to avoid endangering the health of others. The theme throughout is that the health of the adolescent is mainly his own responsibility. The reader is addressed personally and is encouraged to seek in his own body the illustrations of what is said.

The lessons to be learned about how to care for oneself and others emerge naturally in each section, and therefore become not a set of arbitrary rules but the logical outcome of what we know about the mind and body and their health. In relevant places the book includes instruction in elementary first-aid and gives simple corrective exercises for minor defects of posture. Its approach is positive, and it encourages the reader to make the most of his own physique and personality. At the end of each chapter the reader's participation is invited by the posing of straightforward questions and of questions for which alternative right and wrong answers are given, and by a list of things that the reader is asked to do. A number of tests—for example, a weekly diet score test—are set at different points in the book.

On the whole, this book serves its purpose admirably. It is simply and lucidly written, and, although there is inevitably some over-simplification, it is basically sound and full of common sense. It is obviously admirable as a text-book for American high-school children, and would be useful as a teaching brief for teachers of secondary-school children in Great Britain. The section dealing with accidents is particularly good, and in the chapter entitled "Ourselves and Others" there is valuable teaching on human relations by the use of stories about the experiences of other young people.

The only serious weakness is that the sections dealing with human reproduction and sex relations are too short and too superficial. Adolescents are entitled to expect, and should find, more detailed and helpful information on these subjects in a book that is specifically addressed to them. Nevertheless the book does admirably what it sets out to do, namely, to give the adolescent a broad grasp of the fundamentals of health and safety.

ROBERT SUTHERLAND

The Systematic Identification of Organic Compounds

By Prof. Ralph L. Shriner and Prof. Reynold C. Fuson. Third edition. Pp. ix+370. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1948.) 32*s.* net.

IT is probably no exaggeration to say that every monthly issue of the American Chemical Society's *Journal* contains at least one footnote reference to 'Shriner and Fuson'; this is a striking tribute to what is primarily a students' text-book.

Considerable expansion has occurred since the first relatively slim volume appeared fifteen years ago, the present edition being practically twice the size of the original. Basically, the same system has been followed, namely of effecting a first classification, after the usual preliminary observations, by means of solubility (physical and chemical), which is then followed by the more orthodox group reactions. Much of the subject-matter has been re-grouped and re-written; additional classification reagents have been introduced and the preparation of further derivatives described. The tables have been increased in length but not in breadth, so that some of the derivatives for which procedures are given are not tabulated. This seems to be deliberate, since literature references to group reagents are given; but it does mean that derivatives recorded incidentally will probably not be encountered. A minor criticism, which applied equally to the first edition, is that densities, in the few places where they are given, are quoted for an assortment of temperatures ranging from 0° to 25° C.; this is occasionally unavoidable, but for most of the compounds in question, and particularly for hydrocarbons, reliable figures for 20° C. are available. Further, it is strange to see (p. 236) diphenylamine placed among the liquid amines as well as the solid. On the other side, it was formerly difficult to trace the position of a particular compound in the tables, even when the page was known from the index; this has now been overcome by a very simple device.

Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. System-Nummer 18: Antimon. Teil B2: Schluss des Elements verbindungen bis Antimon und Jod. Pp. 129–496. 83.60 D. marks. Teil B3: Schluss der Verbindungen. Pp. xxi+xvi+497–564. 24.75 D. marks. (Clausthal-Zellerfeld: Gmelin-Verlag G.m.b.H., 1949.)

PART B2 of this section on antimony deals with a few iodine compounds and compounds of antimony with sulphur, selenium, tellurium, boron, carbon, silicon, phosphorus and arsenic. As usual, the physical and chemical properties are very fully covered. Phase rule diagrams are given.

The second of these two publications, Part B3, begins in the middle of the electrical properties of antimony, including a section on the antimony electrode, then deals with the chemical and analytical properties of antimony, and the antimony compounds with hydrogen, oxygen, nitrogen and halogens as far as part of the iodine compounds. It thus covers much of the interesting and important parts of the chemistry of antimony. The section on the antimony electrode, which is fully illustrated (an unusual feature in "Gmelin"), is particularly noteworthy. The section on antimonic acid includes the modern formulation as a hexahydroxy compound; but the individual antimonates are not included, these being treated in other volumes under the metals concerned. Compounds quite unknown in the separate form and assumed only from spectra, such as SbF, receive as detailed treatment as the known compounds. This volume is an excellent example of the high standard of the whole work. J. R. P.

Geometry

By Prof. H. G. Forder. (Hutchinson's University Library, No. 19.) Pp. 200. (London: Hutchinson's University Library, 1950.) 7*s.* 6*d.*

THIS is a book of an unusual kind. It is not a text-book, giving a detailed treatment of a limited part of the subject, but an attempt to give a general outline of almost every kind of geometry, from the most ancient and elementary to the most modern and abstruse. It is intended for non-specialists; most of the book assumes only a knowledge of elementary geometry and algebra, though the later chapters require some differential calculus. The first chapter deals with Euclidean geometry by means of displacements and transformations. The second and third chapters deal with plane curves and co-ordinate geometry. The fourth deals with projective geometry. In the fifth and sixth we come to non-Euclidean geometry, with a discussion of the logical structure of different geometries. The seventh and eighth deal with solid geometry, algebraic and differential. The ninth has some of the properties of higher plane curves. The tenth and eleventh give an account of geometry of n dimensions, including Riemann's work, which has attained such prominence in the theory of relativity. Results are given; but it is, of course, impossible to give, in a small book, even a sketch of the proofs of the theorems in the last chapter.

A Bird Photographer in India

By E. H. N. Lowther. Pp. xii+150+79 plates. (London: Oxford University Press, 1949.) 21*s.* net.

HERE Mr. E. H. N. Lowther gives us the results of many years work with camera and hide among the birds of India. Bird photography in the best of climates and under the best of conditions has its trials and difficulties. The heat prevailing in the plains during the main breeding season provides an adverse factor likely to daunt all but the most enthusiastic of bird photographers; but it never daunted Mr. Lowther, who has worked year after year on a diversity of species and with remarkably successful results.

The seventy-nine plates in this book testify not only to Mr. Lowther's zeal and skill but also to the very wide field he has covered. To refer to even a few of the birds he has 'shot' would make a lengthy list. It must suffice to say they are numerous and various—we begin with a crested swift on its nest and conclude with a king vulture; jungle nightjars, skimmers and hornbills being among those encountered as we turn over these fascinating pages. But it must not be thought from this that Mr. Lowther's volume is only a picture book, for such is far from being the case. His observations are many, of high interest and afford excellent reading. In short, despite his photographs having received first mention, they take their proper place as fine illustrations to the record of a naturalist's observations on the bird-life of India, a record on which we congratulate him. FRANCES PITT

SCIENCE, RELIGION AND MORAL JUDGMENTS*

By the Right Rev. E. W. BARNES, F.R.S.
Bishop of Birmingham

WITH the discovery—roughly in the fifteenth century—of the literature of Græco-Roman civilization, the medieval order of Western Europe began to break up. Ancient beliefs crumbled: many old religious superstitions, in spite of the efforts of the powerful and well-organised medieval church, began to seem foolish. Moral judgments changed: for example, to burn a man for heresy began to seem barbarous; to drown an old woman as a witch lost such moral seemliness as it had ever had. Changes in belief led to religious divisions, and they in turn to wars. The more conservative wings of the ancient church continued to proclaim the truth of so-called immutable beliefs; but they silently abandoned ideas and practices which had lost their cogency. So it came about that the post-renaissance world differed profoundly from that of the Middle Ages. The old unity of Western European civilization collapsed. The new disorder, though regrettable in many ways, showed the healthy vitality of hopeful progress associated with more reasonable beliefs.

We are passing from the post-renaissance world to a new era. The discoveries of science are leading to world-wide changes, religious and moral, as profound as those caused in Western Europe by the spread five centuries ago of the ideas of classical civilization.

The first effect of the changes is to produce quarrels out of which wars may only too easily arise. The old outlook coalesces naturally with religious conservatism. The new outlook is the basis of political and social revolutions.

It must be remembered, moreover, that Christian churches, in spite of the teaching of Christ, almost invariably approve of war, 'in a just cause' as the saying is. But humanist intellectuals, with the new scientific outlook, tend to repudiate war and to press for international peace. Quite unexpectedly, a new moral judgment that war is barbarous has arisen among the men of science whose discoveries, to their profound regret, have been used to make war more devilish than ever.

This moral condemnation of war, which in the past has been almost entirely limited to the Quakers, is a surprising outcome of the scientific era. As a characteristic of scientific humanism it is worth careful study. The new humanism is often condemned as the product of intellectuals who have no religious convictions; and it is asserted that such a lack of religious enthusiasm is associated with social insensitiveness. But, in fact, the fundamental principles of the new era are two in number, the veneration of knowledge and research and a regard for man's social well-being. Analyse these principles and one begins instinctively to say to oneself, "Thou shalt love the Lord thy God with all thy mind" and "Thou shalt love thy neighbour as thyself". Who is my neighbour? The reply comes back through the centuries: he is the hated enemy of my people—the Samaritan.

The scientific intellectual, trying by his research to understand more fully the pattern and significance of the universe, and rating kindness as a more valuable social principle than the patriotism that springs often enough from fear, is a religious man, Christian in sympathy, even though he stands apart from formal religion.

Yet, often enough, the new outlook of the scientific era is assumed to be anti-Christian or even atheistic. Current controversy uses the assumption, and it gains plausibility from some Communist teaching; but it is not justified by facts.

The modern intellectual finds God through Nature: Spinoza's *Deus sive Natura* is at the basis of his theology. He builds upon research and discovery rather than upon revelation. He does not on principle repudiate revelation. He retains an open mind because he finds that too often what is asserted to be revelation is associated with those traditional judgments of fact and fiction, of right and wrong, which he rejects. But his religious sympathies find a basis in the fact that his discoveries in the realm of physics reveal a planned world, the product apparently of a Mind, like to, though in quality and power transcendently surpassing, that of man. Current biological progress confirms and amplifies this understanding. So it becomes difficult to deny the existence of God, if the term be applied to the active Mind behind phenomena. The purpose of the plan of creation is by no means clear, or at any rate as clear as we could wish. Yet, arguing from instincts which are, he is convinced, of supreme value, the intellectual who builds religious faith on science tends to believe that God's nature and purpose are to be found in kindness. So in human life his final emphasis is on the brotherhood of man; and he tends increasingly to stress the need for kindness to lower animals who are also man's kinsfolk.

Probably it is true to say that the teaching of Jesus is more valued in the modern scientific civilization that is now being built up than it was in the post-renaissance world. Consider, for instance, the Chinese civilization that is now under the impact of changes emerging from Western humanism. It was polygamous, its leaders fighting for wealth and power. The new revolutionary leaders of China have surprised the world by their practical repudiation of traditional avarice. Largely by moral influence they have conquered territories containing millions of men with comparatively little fighting; they have now denounced polygamy and cognate ills. Thus a new civilization, Confucian but also scientific, in sympathy with Christian idealisms, is arising among a people who can boast the oldest tradition of continuous civilized living known on earth. We cannot say what will happen when Chinese universities are fundamentally transformed by modern science—so far the transformation is in its infancy—but the

* Substance of the Evening Discourse delivered on September 3 at the meeting of the British Association in Birmingham.

future is of much promise. We can gain hope from this promise, for Western European civilization, under surface hypocrisies, had anti-Christian standards of living similar to those of unregenerate China. There is in science an austerity not to be found in war or predatory business. For this reason a scientific education is a purifying influence: it is a true humanism.

We must lay great stress on these facts as we consider the changes in moral judgment to which I wish now to direct attention.

The most significant development which we observe in our science-controlled world is the vast increase in human fecundity. Medicine, as never before, is winning the fight against disease, and especially against illnesses fatal to infants and adolescents. As a result, population in most areas is increasing faster than food supplies. Malthus saw this possibility a century and a half ago. Happily the increase since then of the fertility of newly developed areas and the slow progress of preventive medicine saved the situation for the time being. Now the world begins to find itself almost everywhere over-populated.

Analyses of the causes of unrest in various parts of the world have of late been fairly frequent. Almost always one finds embedded in them, behind a façade of political words, some reference to a population increase associated with semi-starvation. For instance, social disorder in some of the West Indian islands is dangerous. Poverty is endemic. One island has been described as a vast slum where legitimacy statistics are lamentable. Can we be surprised that in some of these islands the inhabitants avail themselves of a citizenship which enables them to overflow into Britain, where we find their presence a social burden? I put to you the thought that the old command, "Be fruitful and multiply and replenish the earth", could be deemed divine so long as the world needed more human beings. The primitive need has passed. Now the world needs more good human stocks; but inferior stocks are increasing far too rapidly and are a menace to the future.

It is unnecessary to say that no race, no human group, no family, thinks itself rightly to be classed as inferior. The more numbers increase, the fiercer becomes the struggle for existence. Yet, almost everywhere, the self-denial needed to limit population-increase is deemed a folly: the consequent rapidity with which the world-situation alters for the worse cannot but cause anxiety to all thoughtful people. Half a century ago most churches condemned birth-control as immoral. To-day only the most reactionary maintain that view in Great Britain. There seem to be signs that the Roman Catholic Church is modifying its attitude even in southern Italy, where dreadful poverty and fierce discontent are increased by American refusal to accept mass immigration. I personally can find nothing in Christ's teaching to cause us to welcome unrestricted population-increase when its direct outcome is a vast growth of human misery.

Once it is seen that in the new science-controlled world we are in danger of over-population, the doctrine that human life is inherently sacred becomes questioned. The doctrine remains axiomatic if the life be that of one who could be said to have been made in the image of God, a good man, healthy, and strong, to give to humanity moral aims and a wholesome example. Yet, while the need for great and good leaders of humanity was never greater than at present, we cannot assert that love of our neighbour is a principle that should prevent us from trying to limit the increase of bad stocks. We should give to all human beings who are born opportunities of healthy and wholesome living. But we must accept the certainty reached by eugenic investigation that inherent degeneracy is not a product of slum life. Nor can it be cured by better housing conditions or more ample food supplies: it is a consequence of dysgenic changes; and of their ultimate origin we are ignorant. So the question arises: Is human life always sacred, whatever its quality or circumstances?

In the realm of this inquiry, as we all know, disturbing problems insistently press forward. Would God, as Christ revealed Him, in all circumstances disapprove of euthanasia? Owing to the progress of medical science, the length of life of men is increasing. We are living longer than our parents, and many live too long for happiness. It is becoming almost a commonplace to hear a man say that his father lived too long: he would have been happier had death come sooner. Sometimes the man will add, "he and the rest of the family would have welcomed euthanasia". So clergymen and others of undoubted sincerity and Christian earnestness are pressing for legal change.

Other associated alterations of public opinion are showing themselves. In the post-renaissance era which is now reaching its end, suicide carried a grave social and religious stigma. But now a kindly coroner makes a formal excuse and a religious service is rarely refused when suicide has ended physical malady. Of course, euthanasia, as a mode of death, differs *in toto* from suicide in that a man is not renouncing his own life but concurring with the judgment of others. But can we always say that either is an affront to God as Christ revealed Him? Most of us, while condemning suicide in the abstract, would suspend judgment in a particular case, urging lack of knowledge of the circumstances. Enforced suicide excites indignant condemnation of the man who imposes it, though not of the victim; condemnation of Hitler, not of Rommel.

Probably the test of cruelty will be increasingly applied to a number of the problems now becoming insistent. Hitler's treatment of Rommel was cruel, and his agents, like himself, deserved to be punished for cruelty. But when a medical man gives an overdose of morphia to a patient likely to have but a short time of misery while life lasts, he is animated by kindness, not by cruelty. He combines, in fact, knowledge and goodness, the two fundamental principles on which, I have suggested, our new scientific civilization will rest.

In the immediate future our new civilization is likely to have many a struggle within itself as its leaders see the ideal that should be sought and lack the knowledge by which it may be attained without action which some will judge to be worthy of moral censure.

We have come to know that both grave physical defects in man and mental degeneracy are alike inherited. Progress in the science of genetics during the last half-century has revealed that the genes in the chromosomes of the living cell, alike in human beings and in other animals and plants, are carriers of hereditary units. These units change, sometimes for the worse, sometimes for the better. The causes of the changes are little understood, though it is known that some of them can be induced by radio-

activity. When deleterious units appear, a new type of human being results with physical or mental defects that may make it unfit for civilized life. So far we know little of the location of defective genes within the living cell and nothing as to how they can be eliminated before mating. But there is a close likeness between human beings and other higher mammals; and no breeder of domestic animals would breed from individuals similarly tainted. Sooner or later, as over-population becomes acute, the question of preventing the increase of tainted human stocks will have to be faced; and violent controversy is likely to ensue. Our present knowledge is sufficient to warrant the statement that sterilization in cases of mental defect would only be partially effective, though in view of the increasing number of mentally defective persons in Britain there is much to be said for the argument that half a loaf is better than no bread. Too often in our newspapers we read the verdict "guilty but insane" after some dreadful crime by a mental and moral degenerate. Is the outcome of the verdict to be lifelong imprisonment rather than kindly euthanasia? I confess that I can give no confident answer to this question.

From time to time, new mutations lead to the birth of children horribly defective or deformed. They can never grow up to have a normal happy existence. The question of euthanasia at birth for such infants is seldom discussed in public, but undoubtedly the practice is accepted as a regrettable necessity by some members of the medical profession. It would not appear to conflict with the fundamental religious principles of our developing scientific civilization.

Objections to sterilization and euthanasia gain strength from a belief that the defects to which they could be applied arise from what we may popularly describe as 'slum conditions'. The belief, as I have said, is mistaken. But it is strongly held and, like other primitive though mistaken beliefs, is most difficult to eradicate.

Mental and moral defectives tend, in populous industrial areas, to congregate in districts where their habits of life lead to overcrowded and insanitary houses. An enthusiast for better housing and social reform, once he has convinced himself that a bad environment produces human degeneracy, tends to find his belief confirmed by all he sees; and regards eugenic reformers as hard-hearted *bourgeois* indifferent to the unhappiness and suffering of the proletariat. Such a man may well become a dangerous reactionary, though he fancies himself a progressive socialist or even communist.

The emergence of sub-normal groups in an over-populated land is at present a cloud no bigger than a man's hand. Before another century has passed it is likely to become a cloud covering the whole sky.

Evidently the need for genetic research applied to humanity is vastly important. Unfortunately, there is already evidence that differences of opinion as to genetics are likely to lead to political and racial quarrels as violent as were religious differences four centuries ago.

The use of euthanasia or sterilization to prevent the increase of tainted stocks is sometimes thought to be a form of punishment, and opposition to either is linked to objection to capital punishment. The fundamental difference needs to be continually emphasized. The mental or physical degenerate is not defective because of any personal fault, and the question of punishment does not enter in. Society needs, and will increasingly need, to prevent the increase of degenerate human stocks. Any action taken must both be kind to the individual and also tend to the ultimate welfare of mankind. It differs *in toto* from the stern punishment which brings a murderer's life to an end. Dislike of capital punishment is undoubtedly increasing, and one reason is the belief that hanging is unnecessarily cruel. Life imprisonment is also cruel, though not so brutal. Should a murderer be likely to repeat his crime, if released, public opinion in the future will probably demand, not his execution, but his painless extinction.

Another problem raised by the destruction of human life is that of abortion. The destruction of an unborn child in a case of rape or to preserve the mother's life receives wide approval. But the use of abortion to protect a girl's good name after a moral lapse would lead to many abuses if ever the practice were legalized. Many an illegitimate child is potentially a valuable citizen, and the killing of such a one should not receive and, in fact, is most unlikely to obtain the approval either of a Christian or of a religious scientist. The problem of abortion is associated with our ethical standards as shown in marriage and divorce. In this realm few moral teachers would reject the ideals of Christian monogamy. These ideals seem to be winning their way in China; but there is unfortunately no evidence of similar progress in the Western democracies. It is in fact, most disconcerting that regard for them seems to fall as the independent status of women rises. So far as such ideals are concerned, biological science seems to be completely neutral, especially now that venereal diseases can be said to be conquered. Among the tasks of the future the maintenance of a high standard of sexual ethics will probably be one of the most difficult. In no other realm of human activity will the union of scientific enthusiasm with Christian idealism be more valuable. I have said that the two main standards of the new scientific civilization will be knowledge and kindness. True to these standards, men and women in marriage must seek to understand the mind of the Creator—or, in Christian language, the Will of God—and to strengthen their union by love.

Sometimes, when the problems of over-population to which I have directed attention are discussed, the plea is made that war will recurrently end our troubles and therefore deserves our approval. There is, unfortunately, little doubt that atomic warfare can be so developed that mass-extermination results. It seems that such a development of atomic energy will be associated with the growth of great industrial areas and that such crowded areas in turn will be peculiarly liable to atomic destruction. Yet it is impossible to view without horror either the manufacture or the use of atomic weapons. The use of such weapons might empty an overcrowded world, but it would bring grave suffering of which most certainly God, as revealed by Christ, would not approve; and which no human being can rightly excuse. He who has heard the call "Thou shalt love thy neighbour as thyself" may without hypocrisy approve of bringing human life to an end when its burden has become intolerable: he cannot, to protect himself from fancied or real enemies, approve methods of mass-murder and mass-mutilation. If the alternative be a pacifism willing to endure and to suffer, let us choose it. We may lose our lives but the loss will ultimately be in the service of mankind.

RHEOLOGICAL PROBLEMS IN BIOLOGY

INTERNATIONAL COLLOQUIUM

DURING July 26–28, a colloquium was held in Lund, attended by workers in a variety of fields of biological study, with the object of surveying problems relating to "the flow and deformation of matter". Such problems are essentially part of the subject-matter of physics; but physicists in the nineteenth and early twentieth centuries quite properly concentrated on the simplest types of rheological behaviour—the Newtonian fluid, with no relevant properties beyond a viscosity and a density, and the Hookean solid, of which examples are to be found in every text-book but in very few other places.

Biological science provides almost no examples of such simple types of behaviour, and scarcely any biological problems have proved to be amenable to treatment along lines suggested by nineteenth-century physical theory. Poiseuille, who wanted to study the flow of blood, had to give it up and study instead the behaviour of flowing water. He made thereby contributions of great value to physics, but left his original physiological problems as obscure as ever.

Developments in the present century—notably the introduction of plastics—directed attention forcibly to the flow and distortion characteristics of materials of high molecular or particle weight, leading to extensions of physical theory which seem likely in the near future to have application to biological problems. A survey of such problems as they exist to-day seemed desirable, and the meeting at Lund was accordingly arranged by the Joint Committee on Rheology of the International Unions of Physics and Biology.

The colloquium, attended by forty to fifty workers from several different biological sciences (and incidentally of ten nationalities), was opened at an informal reception by a short speech of welcome from Prof. Georg Kahlson, who had generously put his Physiological Institute at the disposal of the organisers both for the communication of papers and for the equally important informal discussion that went on during the subsequent three days in the gardens of the Institute.

At the first formal session, under the chairmanship of Prof. Hans Burström, dean of the Faculty of Natural Science at Lund, the meeting considered, appropriately, the rheological properties of protoplasm. Opening the session, Prof. W. Seifriz (Philadelphia), showed films of protoplasmic streaming in the slime mould, an astonishing demonstration of a circulatory mechanism with no permanent vessels and no discernible motive power, with the odd characteristic that the direction of flow is reversed every minute or so. This streaming can be reversibly inhibited by narcotic agents and stimulated to greater intensity by agents such as produce excitation in laboratory animals. The rheological properties of the cell nucleus were the subject of a communication from Prof. J. E. Harris (Bristol), who has measured the rate of fall of the nucleolus under gravity through the nucleus in the oocytes of several species of echinoderms, and revealed unmistakable evidence of thixotropy in the nuclear material. The session was concluded by an account from Prof. H. Pfeiffer (Bremen), of his work on the dichroism of flow in protoplasm streaming through capillary tubes.

A fascinating opportunity for the application of rheological considerations to biology lies in the locomotor activities of animals in relation to the properties of their environment. The mechanics of flight in air and of swimming in water are subjects that have been fairly extensively studied; but the communication of Dr. G. P. Wells (London), on the habits of the lugworm (*Arenicola marina*), dealt with an example of movement in a solid medium. The lugworm lives in a more or less permanent burrow in sandy beaches and feeds by passing sand through its body. The worm lives at a depth of 20–40 cm., yet it is only the surface sand that contains any particles of nutriment. This raises the problem of maintaining a permanent 'head shaft' in the muddy sand, a problem solved by the secretion of a cement substance on the part of the worm; this cement binds the sandy wall of the shaft to a thickness of several millimetres. Not only do the mechanical properties of the beach affect the worm, but also in the course of time a colony of worms may influence considerably the properties of the beach, for example by the formation of horizontal layers of coarse-grained material from which the finer components have been sucked away. These equip the beach with an irrigation system.

The flow of blood in the vascular system has been a subject of study since Poiseuille laid the foundations of the subject by his work on the flow of water in capillary tubes. The flow of blood plasma in tubes presents no phenomena of a puzzling kind; but whole blood is an example of a suspension, and the flow of suspensions is a subject only now beginning to take shape as a rheological topic. Physiologists have had to be content hitherto to collect data in the hope that ultimately these would fall into place in some theoretical scheme. The hope is not yet realized. Prof. R. Fåhraeus (Uppsala), himself a leading authority in this field, outlined the present condition of the problem in a paper beautifully illustrated by microprojection of blood flow in glass capillaries. Prof. Fåhraeus directed particular attention to the fact that in certain pathological states the rheological properties of blood are altered in such a manner that the distribution of flow in a capillary bed may be considerably changed. Dr. J. M. Potter (London), showed a film, prepared by Dr. D. A. McDonald and himself, of the flow of blood in the basilar artery of the rabbit. This artery is formed by the fusion of the two vertebral arteries, and the two streams of blood derived from these arteries remain astonishingly independent. This was shown beautifully in the film by the injection of dyes into either of the two vertebral arteries and by temporary occlusion of either. Some of the records were made at 1,500 frames per second, with a milli-second time-base recorded directly on the film.

Two of the papers presented to the meeting by W. Boothby and G. Lundin (Lund), and by P. Eggleton (Edinburgh), dealt with the elimination of nitrogen gas from the body resulting from the sudden reduction of atmospheric pressure. This physiological problem brings in rheological considerations in three ways: the diffusion of dissolved gas through the tissue cells to the nearest capillary, the transport of this gas by the circulating blood, and the tendency of the gas to separate as bubbles at certain sites within the body. Prof. Boothby spoke of the measurement of gaseous nitrogen elimination by means of the 'nitrogen meter' of Lilly and Anderson (a spectrophotometric technique of high specificity and accuracy), and of the

analysis of nitrogen-elimination curves into 'pulmonary' and 'tissue' components. Dr. Eggleton referred more particularly to the diffusion of nitrogen through fatty tissues and through fats and oils (in which nitrogen is five times more soluble than in water, and through which, on account of their viscosity, diffusion is slow).

The formal programme of the colloquium contained, in all, sixteen communications. This is a very small sample of rheological topics to draw from the whole of biological science, and there is no knowing whether it was representative. The fact that three of the sixteen papers (A. V. Hill, London; F. Buchtal, Copenhagen; and O. Sten-Knudsen, Copenhagen), were concerned with the mechanical properties of muscle, was probably a fair indication, however, of the great interest aroused by this rheological problem, and the substance of these communications illustrated the degree to which this subject has passed beyond the purely descriptive exploratory phase of research into the phase of exact measurement under controlled conditions. Prof. Hill's communication has been printed in *Nature* of September 9 (p. 415), and it is sufficient here to note the interest aroused by his recent results indicating that the stretching of a muscle in the excited state may bring about some endothermic chemical reaction. If a muscle can derive chemical potential energy from mechanical work done upon it, we are far indeed from the simple rheological picture of muscle mechanics—an assemblage of springs and dash-pots—that seemed sufficient twenty years ago.

The two communications referred to above, from the Neurophysiology Department at Copenhagen, illustrated the attempt to simplify the nature of the problem by study of the mechanical properties of single muscle fibres. Buchtal and Kaiser have applied longitudinal vibrations to such individual fibres, and by electrical recording have obtained Lissajou figures on a cathode-ray oscillograph in which the x-component records the alternating applied tension and the y-component the resulting alternating changes of length. The shape of the ellipse produced is affected by the physiological conditions of the fibre and the frequency of the vibration. These authors distinguish between 'elastic stiffness' and 'viscous stiffness'. The former is determined by the resonance frequency of the vibrating system, and the latter by the ratio of load to amplitude of movement at this resonant frequency. The changes in these two dynamic properties induced by electrical stimulation, by loading conditions, by temperature, etc., were the subject of this communication.

Dr. Sten-Knudsen's paper dealt with experiments of similar nature, in which the applied force consisted of an oscillating twist instead of a tension. The response of the fibre to such torsion enables conclusions to be drawn as to the structural forces operating normally to the fibre axis.

Even the stress – strain relations of non-living natural fibres are too complicated to describe in terms of simple viscous-elastic models: Dr. F. Anderson (Copenhagen), described the phenomena of after-stretch or relaxation observable in cellulose fibres subjected to sudden strain. Such relaxation, if attributed (following Eyring and his associates) to 'flow' of cellulose molecules or aggregates, can be used to provide a description of the rheological properties in terms of molecular structure—to determine, for example, the size of the aggregates between which slip is occurring.

Perhaps the most fundamental topic discussed at the meeting was that raised by Dr. M. Joly (Paris). It concerned the structures—transient and microscopic structures—present even in many relatively simple colloidal solutions. The flow characteristics of certain colloids point to the conclusion that reversible dissociation or aggregation of particles can occur as a direct consequence of the shear in the flowing liquid. Extreme examples of such effects are displayed in the phenomena of thixotropy and of rheopexy.

In addition to the communications just described, papers were read by Dr. R. D. Preston (Leeds), on the ascent of sap in trees, Prof. A. Frey-Wyssling (Zurich), on Poiseuille flow in latex tubes, Dr. T. D. Day (Leeds), on the flow of water in connective tissue, and Dr. F. A. Glover (Reading), on the rheology of human uterine secretions; all provoked warm—occasionally heated—discussion, both in and out of the lecture hall.

The success of this colloquium—and those who had attended it appeared all to rate it highly successful—was no chance result, but directly due to the care and forethought of Prof. H. Burström and Dr. A. Deutsch, who acted as local organisers. It was an agreed policy that informal discussion should be an important part of the proceedings; but discussion cannot be brought about by decree. That discussion took place freely and fully was the result of two things. The restricted size of the colloquium made it possible for each member quickly to make the acquaintance of all others; and the provision of a buffet for meals and refreshments in the grounds of the Institute made it unnecessary for members to scatter at intervals in search of sustenance. The generosity of the Swedish Government, which placed a sum of money unreservedly at the disposal of the organisers for hospitality[2], made it possible to provide this refreshment free of charge, and no better way could have been found to make this hospitality effective.

The proceedings of the colloquium will be published as part of a monograph on "Rheological Problems in Biology" now being prepared by Prof. A. Frey-Wyssling (Pflanzenphysiol. Inst. d. Eidg. Tech. Hochschule, Zürich). The cost of publishing the proceedings is borne by a grant from the United Nations Educational Scientific and Cultural Organisation, to which body the organisers of the colloquium are also indebted for a grant of money towards the expenses of the meeting.

OBITUARIES

Prof. A. W. Conway, F.R.S.

Arthur William Conway, by general consent the most distinguished Irish Catholic man of science of his generation, was born at Wexford on October 2, 1875, and died in Dublin on July 11, 1950. He was educated at University College, Dublin, and Corpus Christi College, Oxford, and was elected a junior fellow of the Royal University of Ireland in 1900 and a senior fellow in 1901. In the latter year he was appointed professor of mathematical physics in the old University College, being continued in a similar office when the new University College was created in 1909.

Conway's earliest papers, which appeared from 1902 onwards, were concerned with problems in the electromagnetic theory of light—the reflexion of

electromagnetic waves from moving conductors, the propagation of light in crystals, and general properties of the partial differential equations of physics: in 1904 he made notable advances in the study of fields of force due to moving electrons. These researches led him naturally to the question of the origin of spectra. At that time (some years before Rutherford's discovery of 1911 that the atom is like a miniature solar system, or Bohr's discovery of 1913 that a spectral line is generated when an electron falls from one orbit to another), it was generally supposed that spectra were produced in the same way as sounds are produced by the free vibrations of a material body: that is to say, the atom was regarded as an electrical system of some kind, which had a large number of natural periods of oscillation, corresponding to the aggregate of its spectral lines. Conway, in a paper of only two and a half pages in the *Scientific Proceedings of the Royal Dublin Society* in 1907, was the first to break with this conception, and to enunciate the principles on which the true explanation was to be based: namely, that the spectrum of an atom does not represent the free vibrations of the atom as a whole, but that an atom produces spectral lines one at a time, so that the production of the complete spectrum depends on the presence of a vast number of atoms. In his view an atom, in order to be able to generate a spectral line, must be in an abnormal or disturbed state; and in this abnormal state, a single electron, situated within the atom, is stimulated to produce vibrations of the frequency corresponding to the spectral line in question. The abnormal state of the atom does not endure permanently, but lasts for a time sufficient to enable the active electron to emit a fairly long train of vibrations.

As compared with Bohr's paper of six years later, Conway's work falls short in two respects: first, he associated the spectral line with a single state of the atom, whereas Bohr associated it with the transition between two states; it should, however, be remembered that Conway wrote before Ritz's paper of 1908 had convinced spectroscopists that the frequency of a spectral line is the difference of two 'terms'. Secondly, he did not connect the phenomenon with Planck's quantum of action. For these reasons, Conway's theory did not prove immediately fruitful, as Bohr's did; but the very revolutionary general principles he suggested were perfectly sound, and show a remarkable physical insight.

Conway was probably the most accomplished living manipulator of the quaternion calculus: and in a number of his later papers, he showed its superiority for the formulation both of special relativity and of quantum mechanics. He had a personal devotion to the memory of its discoverer: and had a chief share in persuading the Royal Irish Academy to undertake the publication of a collected edition of Hamilton's works. For the two sumptuous volumes which have so far appeared, and which contain a great amount of matter hitherto unknown, he acted as chief editor.

Conway held the chair of mathematical physics in University College, Dublin, until 1940, when he was elected president of the College, a position from which he finally retired in 1947. He was elected a fellow of the Royal Society in 1915, and served on its Council during 1935–36; he was for terms of years president of the Royal Irish Academy and of the Royal Dublin Society, vice-chancellor of the National University, and chairman of the School of Theoretical Physics in the Dublin Institute of Advanced Studies. He was an honorary fellow of Corpus Christi College, Oxford, and received honorary degrees from the Universities of St. Andrews, Dublin, and the Royal University of Ireland. In 1939 he was appointed a member of the Pontifical Academy of Sciences.

His wife predeceased him; but he is survived by his son and three daughters.

EDMUND WHITTAKER

Dr. L. O. Howard

LELAND OSSIAN HOWARD, who died on May 1 at the age of ninety-two, was a well-known American biologist, administrator and writer, and chief of the Bureau of Entomology of the U.S. Department of Agriculture for thirty-three years. He was born on July 11, 1857, at Rockford, Illinois, and was the eldest child of Ossian Gregory Howard and his wife Lucy Dunham (Turber) Howard, of the famous Pickering family of Massachusetts from whom there also came several other men of science. He was also distantly related to Senator Jacob M. Howard, of Michigan, one of the founders of the Republican Party in the United States, and to William Howard Taft, ex-president of the United States. While still in his infancy his parents removed to Ithaca, New York. He early became interested in outdoor life and natural history, and particularly in the birds and insects. In 1873 he entered Cornell University, and, during the four years that followed, he not only made excellent progress with his studies, but also was particularly fortunate to come under the influence of some outstanding men of science, notably John Henry Comstock, S. H. Gage and the elder Agassiz, whose lectures he had the good fortune at times to attend. Perhaps most important of all, however, he came to know Prof. C. V. Riley. Riley succeeded Towend Glover as entomologist of the Federal Government, and on the recommendation of Prof. Comstock he appointed young Howard, then newly graduated from Cornell at the age of twenty-one, to be his assistant. This was the humble beginning, on November 13, 1878, of a period of Government service that continued for more than forty-nine years. In due course he was assigned to preparation of a manual on silk culture. This formed the beginning of a long series of publications that were issued year after year prepared by Howard and published under name of his chief—a practice not uncommon in those days.

Howard, when thirty-seven, was appointed chief of the Division of Entomology. It is of significance to note that when he became chief the total annual appropriation for Federal entomological work of all kinds was only 30,000 dollars; when he retired, thirty-three years later, in 1927, at the age of seventy, the annual appropriation was 3,000,000 dollars. During the ten-year period that followed from 1894 to 1904, there occurred three events that fixed the attention of the whole country upon the importance of entomological work: the first of these was the discovery of the gypsy moth in Massachusetts in 1889; the second was the discovery of the San José scale in the United States in 1893; and the third was the discovery of the Mexican cotton boll weevil in Texas in 1894. The research work performed on these problems was in addition to that on other insect pests previously being studied, and obviously required considerable additional funds and increased

personnel, and these resulted in substantial growth of every phase of the organisation. In 1904 there was put into effect by Congress the plan of organisation of Federal entomological work by which separate units were established for investigation of pests affecting the various host plants, namely, field crops, fruits, truck crops, forest- and shade-tree insects, and the like. With various modifications, changes and additions made necessary over the years, essentially the same general set-up remains in effect at the present time in the Bureau. It was also on July 1, 1904, that the entomological work of the Department was raised to Bureau status.

A notable addition to the striking events of the last decade of the nineteenth century was the discovery by Ross in 1898 of the carriage of malaria by *Anopheles* mosquitoes. As a result of this and other discoveries, medical entomology became a most important field of investigation and demanded the intimate co-operation of pathologists and entomologists, and in all these Dr. Howard played an honourable part.

From 1896 until 1930 Dr. Howard was recognized by being given degrees from several institutions. These included the Ph.D., M.D., LL.D. and D.Sc. More than nine hundred publications came from the pen of Dr. Howard during his creative years, including not only his official reports and bulletins and a veritable stream of periodical articles, but also several books, notably "The Insect Book", 1901; "Mosquitoes", 1901; "The House Fly", 1911; "Mosquitoes of North America", 1912–17 (four vols., joint authorship with H. G. Dyar and Frederick Knab); "History of Applied Entomology", 1930; "The Insect Menace", 1931; and "Fighting the Insects: an Autobiography", 1933. In addition to all this, many home and foreign honours were conferred upon him.

J. S. WADE

NEWS and VIEWS

Commonwealth Viticultural Research Station, Merbein, Victoria

MR. FRANK PENMAN, chief irrigation officer of the State Rivers and Water Supply Commission of Victoria, has been appointed to the Commonwealth Viticultural Research Station, Merbein, and will succeed the present officer-in-charge, Mr. A. V. Lyon, when the latter reaches the retiring age shortly. Mr. Penman holds the degree of M.Sc. of the University of Melbourne, and is a fellow of the Royal Australian Chemical Institute. He has had very considerable experience in research into problems of soils and irrigation, especially in relation to vine and citrus culture, and was for many years an officer of the Department of Agriculture, Victoria.

Mr. Lyon has been in charge of the work of the Station since it was first started by the Mildura and District Research Committee in 1919. He continued in that position when the Station was taken over by the Council for Scientific and Industrial Research in 1927. The work of the Station has contributed towards the major advances that have been made in the viticultural industry of the region since the First World War. Mr. Lyon has also made a notable contribution in providing personal detailed advice to the settlers during the critical years of many irrigation settlements along the Murray.

Economics of the Family

PUBLICATION of the Report of the Royal Commission on Population has been followed by a series of papers, and the fifth volume, entitled "Memoranda Presented to the Royal Commission" (pp. 120; London: H.M. Stationery Office, 1950; 3*s.* net), which has recently been published, contains an important contribution on "The Economic Position of the Family", by Mr. J. Hajnal and Prof. A. M. Henderson. The authors of this paper, after discussing the various ways in which parents meet the extra cost of bringing up children, by comparing their expenditure with that of childless couples having the same income, conclude, first, that at all income-levels parents have to make considerable economic sacrifices to maintain their children, and, secondly, that children in large families have a lower standard of living than children in smaller families. Even at relatively high income-levels, parents meet a large proportion of the cost of their children by reducing their own expenditure on necessaries (for example, clothing) and buying cheaper kinds of goods to satisfy their requirements (for example, food). The cost of children is not met only by spending less on luxuries. The economic position of the family has been considerably affected by the changes of conditions since 1938. It would seem that, despite the large increase of prices and incomes, the actual money cost of a child to its parents, at a low working-class level of income, is substantially unchanged as compared with the pre-war figure. The burden of two children, which at this income-level was about a third of a childless couple's income, has now fallen to one-sixth. The raising of the school-leaving age, however, has meant that the burden lasts a year longer. Other papers in this volume include several on "The Relation between Intelligence and Fertility", by Sir Godfrey Thomson and other contributors, and a special memorandum submitted by Mr. R. F. Harrod in which he advocates family endowments proportionate to income through compulsory insurance.

National Forest Park of Glen Trool

THE latest of the National Forest Park Guides (H.M. Stationery Office; 3*s.*) describes the 110,000 acres which comprise the five forests, Glen Trool, Carrick, Cairn Edward, Changue and Kirroughtree which the Forestry Commissioners have grouped to form the National Forest Park of Glen Trool. All these forests are places of great natural beauty, and it is gratifying to know that several proprietors and tenants of lands in the vicinity of the Forest Park have agreed to allow walkers to use fixed routes across their properties. These routes are indicated in the map that accompanies the guide-book, which also contains articles on the mountains, lochs and rivers by H. L. Edlin; geology by Prof. G. H. J. Daysh; plant life by Prof. J. R. Matthews; and wild animals and birds by Gavin Maxwell. J. R. Thom, conservator of forests for South Scotland Forestry Commission, describes the forests and plantations, and Andrew McCormick gives details of

seventeen of the most pleasing walking routes through Glen Trool. The Gaelic derivations and English versions of the place names are enumerated by Kevan McDonald, while the Guide also contains suggestions to help newcomers to Glen Trool to find their way to and about the Park.

Experiments on the Cornish Pilchard Fishery

An account by Dr. W. C. Hodgson and Mr. I. D. Richardson of some experiments conducted on the Cornish pilchard fishery during 1947–48 is given in a recent Ministry of Agriculture and Fisheries publication (Fishery Investigations, Series 2, 17, No. 2: The Experiments on the Cornish Pilchard Fishery in 1947–48; pp. 21. London: H.M. Stationery Office, 1949. 2*s*. net). The aim of the experiments was primarily to establish whether or not the landings of pilchards can be increased or stabilized so that the canning factories may receive adequate and steady supplies of these fish in order to offset the loss of imported canned pilchards. A general survey of the fishing area between Plymouth and Mevagissey was made, employing a ring net such as is used by Scottish east-coast fishermen for herrings. The net was slightly modified, but, even so, was not quite suitable for pilchard work. Echo-sounders were used for locating the shoals, augmented on occasion by the Scottish 'feeling wire' method of fish detection. The experiments showed most convincingly the extraordinary effectiveness of the echo-sounder in locating pilchard shoals and in determining their extent and depth. With echo-sounders in use, therefore, precision fishing, in regard to both place and depth, becomes possible, with resultant increase of catches and reduction of time and expense. A number of very striking echo-sounder 'traces' of pilchard shoals is given. During the survey, opportunity was taken to make various scientific observations on the natural history and biology of pilchards in Cornish waters.

Bird Ringing in 1949

The thirteenth report of the Bird Ringing Committee of the British Trust for Ornithology shows that the ringing of a total of 57,461 birds in 1949 exceeded the previous highest total of 1939 by 1,644 (*British Birds*, 43, No. 6; June 1950). The largest single contributions to the list come from the bird observatories. Among species ringed for the first time were the black-headed bunting, rustic bunting, black-eared wheatear, greenish warbler, purple sandpiper and bar-tailed godwit, while starlings were successfully ringed at roosts in Trafalgar Square by members of the London Natural History Society.

Individual recoveries of special interest include the first from abroad in the case of the lesser redpoll, two ringed as nestlings in the north of England having been reported in Belgium. A reed-warbler and a roseate tern, both recovered in September in Douro Province, Portugal, were also the first of their species to be reported from abroad. A linnet ringed as a nestling in Leicestershire and recovered in October at Cuenca, Spain, and a meadow-pipit ringed as a nestling in Fife and recovered in December at Mazagan, western Morocco, represent the most southerly records for ringed birds of these species. A record of a starling, ringed in Sussex in early November and recovered at Bordeaux three weeks later, is the first of its kind, and suggests a bird of different native origin from most of the winter visitors to Britain of this species. Fast travelling was shown by a wheatear ringed in Skokholm in August and recovered in Landes, France, two days later, while longevity was shown by a teal ringed in Northern Ireland and shot near Lisbon in its eleventh year.

The Amsterdam Naturalist

In Holland, as elsewhere, the number of scientific journals intended for specialists is very large, while most of the popular publications are often of little interest to the more scientifically minded. Members of the staff of the Zoological Museum, Amsterdam, have therefore decided to produce a monthly journal of real scientific standing adapted to meet the needs of the general reader. The journal has been called *The Amsterdam Naturalist*, and the first issue appeared in April 1950. In this issue are articles on the emperor penguin by K. H. Voous, a re-diagnosis of the fish genera *Wannostomus* and *Pœcilobycon* by J. J. Hoedeman and tumours in whales by A. Stoik; the journal also contains a section of notes and news. All articles are in English, and contributions to future issues are invited from biologists and naturalists. The annual subscription is 16*s*.

Preparation of Scientific Papers

A pamphlet, entitled "General Notes on the Preparation of Scientific Papers" (pp. 26. London: Cambridge University Press, 1950. 2*s*. 6*d*. net), has been prepared by a subcommittee of the Information Services Committee of the Royal Society, under the chairmanship of Prof. G. L. Brown, as the outcome of concern expressed at the Royal Society's Scientific Information Conference in 1948 about the quality of scientific papers presented for publication. The pamphlet is of a general nature and is concerned with the presentation rather than with the writing of scientific papers. It is intended to supplement and not replace those specific instructions to authors which are issued by many societies and other publishing bodies, and it emphasizes a number of points in the latter instructions to which authors should pay stricter attention. Some sections of the pamphlet should also be of assistance to typists copying papers, and some of the sections, such as those dealing with nomenclature, symbols and abbreviations, conveniently bring together the sources of reference. The final section consists of a short bibliography which might, with advantage, be extended, for the books on writing, in particular, are too limited.

Forecasting Potato Blight

A recent study by Dr. John Grainger ("Forecasting Outbreaks of Potato Blight in West Scotland", *Trans. Brit. Myc. Soc.*, 33, 82; 1950) amplifies the suggestions of Beaumont (*Trans. Brit. Myc. Soc.*, 31, 45; 1948) that a minimum temperature over 50° F. and a minimum relative humidity over 75 per cent for forty-eight hours in succession would provide a suitable climate for an outbreak of potato blight within fifteen to twenty-two days. Dr. Grainger finds it necessary to specify a "zero time" (the end of June for south-west Scotland) before which such predictions would be invalid. Little correlation between the amount of foliage blight and yield could be demonstrated, although a postscript to the paper suggests that later work reveals a considerable total loss of as much as 25 per cent. A relationship appeared between the rate of development of foliage blight and the amount of blight appearing on the tubers. Years of slow development of the disease on the foliage were found to result in higher tuber

infection and *vice versa*. There was also a tendency towards an increased proportion of ware-sized tubers in years of slow development of blight on the foliage.

Flanged Steel Plug Valves for the Petroleum Industry

BRITISH Standard 1570 (1949), which bears the title "Flanged Steel Plug Valves for the Petroleum Industry" (pp. 31; London: British Standards Institution, 1949; 7*s*. 6*d*. net), has recently been issued. It is based on American Petroleum Institute Standard 600*B* dealing with the same subject and has the advantage, therefore, of ensuring interchangeability between American and British equipment. This specification covers the design and manufacture of flanged steel plug valves, materials involved, workmanship, dimensions, appropriate tests, marking, inspection, preparation and dispatch, and also form of manufacturer's guarantee. Appendixes are provided giving details of the materials to be used. Included are drawings of plug valves and end-flange facings as required by the various classes of valves dealt with.

Application of Ultrasonics

THE May issue of the *Proceedings of the Physical Society* (63B, 305; 1950) contains a summary, by Dr. G. Bradfield, of the National Physical Laboratory, of the proceedings of the symposium on the applications of ultrasonics held by the Acoustics Group on February 18, 1949. Recent advances in the investigation of the fundamental structure of matter, telecommunications and allied applications, and the use of mechanical forces set up by intense waves were surveyed. The derivation of elastic constants of substances using single crystals was considered an important field of investigation. With regard to suitable sources of ultrasonic power, the importance of barium titanate as a powerful and strongly coupled piezo-electric transducer was pointed out. Calculated optimum frequencies for propagation over various distances with minimum attenuation for various gaseous and liquid media are in accord with those found experimentally in echo-sounding, earth exploration and in propagation in metals. The success of various applications of ultrasonics in industry and in navigation was discussed, and attention was directed to the present lack of industrial application of intense waves, though many spectacular laboratory experiments have been performed with them. It would appear that it is more profitable to use ultrasonic waves for irreversible actions such as killing bacteria, cleansing, dislodging oxide films, removing dissolved gases and the precipitation of aerosols.

St. Ives Research Station of the Board of Greenkeeping Research (1929-50)

THE twenty-first anniversary of the St. Ives Research Station at Bingley, Yorkshire, of the Board of Greenkeeping Research was celebrated by a series of functions, at the Station, during September 14–16. The first two days were devoted to golf courses and sports grounds, respectively, and attendance was restricted to representatives of affiliated clubs and other organisations; Lord Brabazon of Tara, past president of the English Golf Union, opened the celebrations on September 14, and Mr. A. Brook Hirst, chairman of the Football Association, those on September 15. On the third day the proceedings were open to the general public, who were afforded the opportunity of seeing at first hand the many ways in which the Station is helping to achieve the best possible playing conditions in all sports using turf (see *Nature*, July 1, p. 22). There was a series of exhibits illustrating the development of the Station's research and investigational work during the past twenty-one years, the growth of the advisory service and the educational facilities made available by the Board; and short lectures and practical demonstrations were also given, together with a display of modern turf machinery and implements.

Fuel Cell at the British Association Exhibition

IN an article on "Energy in the Service of Man", describing the recent exhibition at Birmingham in connexion with the meeting of the British Association (*Nature*, September 2, p. 386), it is stated that the fuel cell exhibited was constructed by the British Coal Utilization Research Association; this is incorrect. The exhibit consisted of experimental hydrogen cells constructed in the Research Laboratories of the British Electricity Authority, with ancillary apparatus. The cells are of the type:

H_2 (silver-active carbon) | aqueous K OH | (nickel-active carbon) O_2

and are modified versions of that constructed in the U.S.S.R. by O. K. Davtyan ("Direct Conversion of Chemical Energy of Fuel into Electrical Energy", Moscow, 1947: Academy of Sciences, U.S.S.R., 48 pp.). One of these cells was shown in operation, but it has not been possible in preliminary experiments to obtain outputs as high as those claimed by Davtyan. This simple type of cell serves to demonstrate the principle of fuel-cell action, but in order to obtain worthwhile current densities, more elaborate constructions would probably be required, such as the high-pressure cell developed by the Electrical Research Association. Even so, the high cost of hydrogen at present would make it uneconomic, so that future research must be directed towards the evolution of a cell operating on a cheaper fuel, such as water, gas, or better, coal itself. In this connexion, a diagram of a cell constructed in the laboratories of the British Coal Utilization Research Association (McKee, J. H., and Adams, A. M., *Fuel*, 28, 1; 1949) was shown. This employs carbon as fuel and operates at a high temperature, but for various reasons its overall efficiency is low.

United Kingdom Postgraduate Awards

PUBLISHED by the Association of Universities of the British Commonwealth, the Universities Yearbook for 1949–50 contained *inter alia* two useful appendixes; one describing postgraduate awards tenable at universities in the United Kingdom, and the second containing a short list of some of the more important awards tenable by British graduates overseas. In accordance with a resolution at the Congress of Universities of the Commonwealth in July 1948 that each country in the Commonwealth should prepare a list of postgraduate and research awards tenable at its universities by students, the Association of Universities of the British Commonwealth has reprinted these appendixes as a separate booklet. In the first Appendix the awards are set out clearly under different subject headings to indicate those which are open to graduates of United Kingdom universities, those which are open to graduates of British universities overseas, as well as awards which

are open to graduates of universities outside the British Commonwealth. The booklet may be obtained from the Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1.

Royal Astronomical Society : Dublin Meeting

THE Royal Astronomical Society is to hold a meeting in the rooms of the Royal Irish Academy, Dublin, during September 21–23. An ordinary meeting for the discussion of papers will be held on September 22. A discussion on problems of solar physics, some of which will be concerned with matters relating to the forthcoming solar eclipse, has been arranged by the Dunsink Observatory, and will be held on September 21, under the chairmanship of Prof. H. B. Brück. On September 23 there will be a Geographical Discussion on "Planetary Atmospheres". A popular lecture, arranged by the Royal Astronomical Society in co-operation with the Irish Astronomical Society and University College, Dublin, will be given by Sir Harold Spencer Jones in University College, Dublin, on September 22 ; Sir Harold will speak on "Time". There will be a reception at Iveagh House by the Minister of External Affairs on September 21, and excursions to Dunsink and Armagh Observatories and to other places have been arranged.

Building Documentation Conference, Paris

THE first general assembly of the International Council for Building Documentation will meet in Paris, at the invitation of the French Government, during October 23–28. Subjects for discussion will be : exchange of abstracts and information ; terminology ; classification ; format and lay-out of publications ; data sheets ; the needs of the users of information. The United Kingdom delegation and observers will be nominated by the British Building Documentation Committee (Secretariat : Ministry of Works Library, Lambeth Bridge House, London, S.E.1), from whom further particulars may be obtained.

Joint Commission for Spectroscopy

THE Joint Commission for Spectroscopy, the purpose of which is to promote and co-ordinate original research in atomic and molecular spectra, is a joint commission of the International Union of Pure and Applied Physics and of the International Astronomical Union. It was formed in 1949 and consists of twelve members, six drawn from each of the two Unions. It is under the auspices of the International Council of Scientific Unions and is supported by Unesco subventions. The first meeting of the Commission will be held in conjunction with the Faraday Society Conference on "Spectroscopy and Molecular Structure" which will take place in Cambridge during September 25–28 (see *Nature*, July 15, p. 97). On the three evenings of September 26–28 the Commission will hold technical discussions in Trinity College. On September 29 a short symposium will take place in the Cavendish Laboratory. All who are interested in the work of the Commission are invited to participate. Lodgings, etc., may be reserved through the Secretary of the Faraday Society, 6 Gray's Inn Square, Gray's Inn, London, W.C.1. The provisional secretary of the Joint Commission for Spectroscopy is Prof. C. J. Bakker, Zeeman-Laboratory, Pl. Muidergracht 4, Amsterdam-C, The Netherlands.

Announcements

PROF. L. JÁNOSSY, senior professor in charge of the Cosmic Ray Section of the Dublin Institute of Advanced Studies, has accepted an invitation to a professorship in the University of Budapest (his native town). He was formerly at the University of Manchester, and moved to Dublin in March 1947. He left for Budapest on August 11.

LORD DERBY will open the new laboratories of the British Hat and Allied Feltmakers Research Association at Stanley House, Manchester Road, Fairfield, Manchester, on September 19 at 11.30 a.m.

THE ninety-fifth annual exhibition of the Royal Photographic Society was opened by Mr. L. V. Chilton on September 14 in the Society's House, 16 Princes Gate, London, S.W.7 (close to the Albert Hall) ; the exhibition is open to the public, without charge, until October 15 from 10 a.m. to 8 p.m. (Saturdays, 10 a.m.–5.30 p.m. ; Sundays, 2.30–5.30 p.m.).

THE tenth series of postgraduate lectures, arranged by the Oil and Colour Chemists' Association, will be held this year at Manchester (at Cheetham Town Hall, Cheetham Hill Road, Manchester 8) on September 29, October 6 and October 13 at 6.30 p.m., when Dr. A. S. C. Lawrence will give a course of three lectures on "Topics in Colloid Science". The fee for the course is 10s., and applications for tickets should be made to Mr. John Hannaford, Secretary and Treasurer, O.C.C.A., Aldwych House, Aldwych, London, W.C.2.

A SCIENTIFIC conference on milk production, to be held in Paris during November 28–30, is being organised by the Centre National de Coordination des Études et Recherches sur la Nutrition et l'Alimentation. The conference will follow the lines of those on bread and on food fats held in 1948 and 1949 respectively. The programme is in three sections : production and genetics ; production and feeding ; and pathology and hygiene of production. Further particulars of the "Journées Scientifiques de la Production du Lait" can be obtained from the Centre National de Coordination des Études et Recherches sur la Nutrition et l'Alimentation, 71 Boulevard Péreire, Paris (17e).

A SUMMER school on electrical resistance strain-gauge methods, organised by the University of Cambridge Engineering Department jointly with the Stress Analysis Group of the Institute of Physics, will be held in Cambridge during September 25–30. The school will be run on the same lines as those held in 1948 and 1949, and its purpose is to provide graduates in engineering, physics or allied subjects, who have not previously used such strain gauges, with the introductory theory to the subject and practical instruction. Further particulars and application forms may be obtained from the honorary secretary of the Stress Analysis Group, Mr. E. K. Frankl, Engineering Laboratory, Trumpington Street, Cambridge.

ERRATUM. In the communication entitled "Thermal Decomposition of Potassium Perchlorate" in *Nature* of July 15, p. 109, column 2, line 4 from bottom, for "nitrate" read "chlorate" ; the formulæ below the graph should be $KClO_4$ and not $KClO_3$ as printed.

POST-TETANIC POTENTIATION OF RESPONSES OF MOTONEURONES

By Prof. J. C. ECCLES, F.R.S., and W. RALL
Department of Physiology, University of Otago, Dunedin, New Zealand

RECENTLY, Lloyd[1] has shown convincingly that after repetitive stimulation of afferent fibres from muscle there is a large potentiation of all reflex effects (excitatory or inhibitory) directly produced by impulses in those fibres. Since this post-tetanic potentiation is not associated with an increased excitability of the motoneurones as tested either by a synergic afferent volley or by an antidromic volley, it must be agreed with Lloyd that it is restricted to the specific *presynaptic* pathway that has been tetanized. We have recorded post-tetanic potentiation after a much wider range of conditioning tetani than were used by Lloyd[1] and also have made a detailed survey of the immediate post-tetanic period. Our experiments give general confirmation of Lloyd's observations and provide in addition many data relating to the time course of development of post-tetanic potentiation and to the effects of variations in duration of the conditioning tetanus. These results will be fully reported elsewhere. The present communication concerns the application of post-tetanic potentiation to the experimental testing of two hypotheses relating to synaptic transmission.

(1) It has been postulated[2,3] that presynaptic impulses act on motoneurones by generating thereon local areas of depolarization (local responses), which, if sufficiently dense, will spread and fuse to form, eventually, an impulse that is propagated down the axon (the reflex discharge). If the synaptic stimulation is inadequate in intensity or the anæsthesia deep enough, the local responses will fail to spread and be propagated, and then merely generate the slow negative potential (called the synaptic potential)

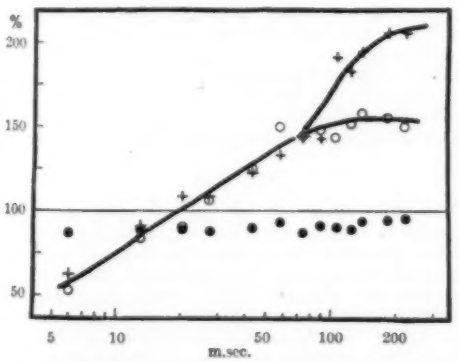

Fig. 1. After a conditioning tetanus of 50 volleys at 300 a sec. (quadriceps nerve as afferent), a test volley in that nerve was set up at the intervals indicated by the abscissæ (logarithmic time-scale). The sizes of focal presynaptic spikes (closed circles), focal synaptic potentials (crosses) and ventral root synaptic potentials (open circles) are plotted as percentages of the respective mean control values (cf. Fig. 2 for method of measurement). The additional rise in the focal synaptic potential beyond 100 m.sec. is due to the spike potentials of the potentiated reflex discharges, which were also seen with the ventral root records, but did not there complicate the measurement

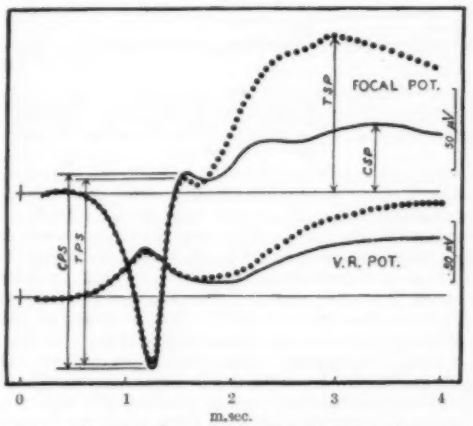

Fig. 2. Each curve is drawn as the mean of four closely similar records which were enlarged by projection. The continuous line shows the control records, while the line of circles gives the test response at 165 m.sec. after a conditioning tetanus of 100 volleys at 300 a second. C.P.S. and T.P.S. represent control and test presynaptic spike, respectively; C.S.P. and T.S.P. represent control and test synaptic potential, respectively, of the focal record. These records were obtained under conditions of deep anæsthesia in order to eliminate reflex discharge

that is recorded either focally by a micro-electrode close to the motor nucleus, or after electrotonic spread along the motor axons to the emerging ventral root[4]. Even when there is a reflex discharge, it may be seen to supervene on a brief rising phase of synaptic potential. According to the above hypothesis of synaptic excitatory action, during post-tetanic potentiation the testing presynaptic volley must evoke an increased synaptic potential, for both synergic and antidromic tests show that the excitability of the motoneurones is not increased (cf. above).

On experimental test, it has invariably been found that post-tetanic potentiation of the reflex spike discharge is closely correlatable with the potentiation of the synaptic potential recorded either focally (cf. ref. 1) or from the ventral root. For example, Fig. 1 shows that immediately after a brief conditioning tetanus there is an identical development of focal and ventral root synaptic potentials from an initial depression to a potentiation, which, when large enough, is associated with a reflex spike discharge. Furthermore, these two types of synaptic potential begin synchronously (within 0·05 msec.) at 0·35–0·5 msec. after the arrival of the presynaptic volley at the synaptic knobs[4], and each is potentiated right from its onset (Fig. 2).

It may be concluded that the experimental tests are in close accord with predictions from the above hypothesis, and provide further evidence (cf. ref. 4) that the potentials recorded focally and from the ventral root are generated by the same synaptic excitatory process.

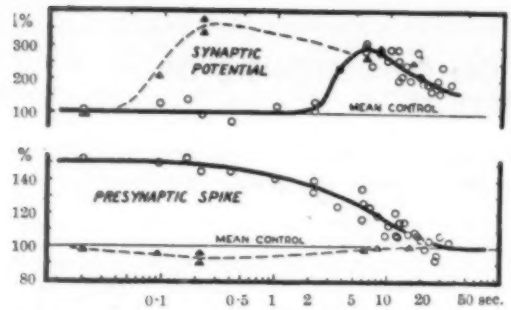

Fig. 3. Plotting as in Fig. 1, but (circles) after a much longer conditioning tetanus (3,000 volleys at 300 a sec.). Triangles show a few observations of the same experiment with conditioning by 50 volleys at 300 a sec. (cf. similar curves in Fig. 1). Note logarithmic time-scale

(2) It has been postulated[1,5] that post-tetanic potentiation is caused by an increase in size of the presynaptic impulses. This hypothesis is based on the general observation that the size of conducted impulses is supernormal in axons which, in their recovery from previous activity, are passing through the phase of after-positivity. Confirmation of this hypothesis requires the observation both of supernormality of presynaptic impulses after tetanus, and the parallelism between such supernormality and potentiation in the subsequent postsynaptic response. Both these observations have been made by Lloyd[1], as shown in his Figs. 13 and 14. However, in our experiments, only after the most severe tetani (10 sec. at 300 a sec.) was there, in part, the parallelism recorded by Lloyd (Fig. 3). The differences may be attributable to differences in technique. For example, we have set up our conditioning and testing volleys in the nerve to quadriceps muscle (the appropriate ventral roots being severed), whereas Lloyd has stimulated dorsal roots. Further, we have recorded both the presynaptic spike and the synaptic potential with a micro-electrode close to the quadriceps nucleus, and have used the synaptic potential as a measure of the potentiation. Thus, in Fig. 2 the initial diphasic spike (C.P.S. and T.P.S.) gives a measure of the presynaptic spike size, while the subsequent synaptic potential has been measured relative to the initial base line as shown (C.S.P. and T.S.P.). Since Lloyd only tested at 2·4-sec. intervals, he may have missed the initial post-tetanic period in Fig. 3, where maximal presynaptic potentiation gives no post-synaptic potentiation. Such a discrepancy between presynaptic and postsynaptic responses might be attributable to an initial post-tetanic depression of the motoneurones. However, at long post-tetanic intervals there is also a discrepancy, for a considerable postsynaptic potentiation remains despite the disappearance of all presynaptic potentiation (circles, Fig. 3). When progressively shorter conditioning tetani are used, the presynaptic–postsynaptic discrepancy becomes so great that no correlation whatever is possible. After 2 sec. at 300 a sec. there is still some correlation; but, with conditioning tetani of 50–100 volleys (Fig. 1 and also the few records indicated by triangles in Fig. 3), no presynaptic potentiation is observed—indeed, there is depression—and yet there is always a large postsynaptic potentiation, which builds up to a maximum in 100–200 msec. (Fig. 1, cf. also the plotted records of Fig. 2). Such observations make untenable the hypothesis that explains post-tetanic potentiation simply in terms of presynaptic potentiation[1,5]. In general, there must be some other explanation for post-tetanic potentiation, though presumably, when presynaptic potentiation exists, it contributes to the post-tetanic potentiation (cf. the concurrent decaying phases at test intervals of 6–30 sec. in Fig. 3).

The most probable postulate for post-tetanic potentiation in general is that the presynaptic impulse becomes a more effective synaptic exciter because repetitive stimulation temporarily alters the spatial relationship of the synaptic knobs to the post-synaptic membrane; for example, the knobs may become larger and/or in closer apposition thereto. It is to be noted that the post-tetanic facilitation process is approximately 30,000 times longer in duration[1] than the facilitation that is attributable to depolarization and increased excitability of motoneurones[3,4,6], and thus is more likely to be related to those prolonged functional changes in the nervous system that occur in conditioned reflexes, and which presumably depend on some change in the form or structure of the synapse. [April 6.

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ORALLY ADMINISTERED ANTIBIOTICS AND THE VENEREAL DISEASES

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THE venereologist now has four potent antibiotics—penicillin, streptomycin, aureomycin and chloramphenicol—perhaps capable between them of curing all the venereal diseases. Penicillin and streptomycin are usually administered by parenteral injection; but aureomycin and chloramphenicol exert their greatest effect when given orally. Streptomycin is ineffective when given by this route although oral penicillin is sometimes used. This article considers the present status in venereology of aureomycin, chloramphenicol and oral penicillin.

Chancroid

Wetherbee *et al.*[1] found that *H. ducreyi* is not particularly sensitive *in vitro* to penicillin or aureomycin. Personal experience, however, indicates that both aureomycin and chloramphenicol, administered to volunteers simultaneously with inoculation of chancroidal matter, will prevent the appearance of soft sore[2]. Zheutlin and Robinson[3] successfully treated three patients with clinical lesions with 2 gm. of aureomycin given orally for 7–14 days. Greenblatt *et al.*[4] consider that 5–10 gm. of chloromycetin will likewise cure chancroid. Oral penicillin also has some action; but the variable concentrations obtained in the blood do not give it any advantage over other drugs.

All three of these antibiotics are anti-syphilitic, and may, therefore, mask an undetected syphilitic

infection without necessarily curing it completely, and none should be employed for chancroid as a routine. Sulphonamides, which do not mask syphilis, are the drugs of election. Although single injections of streptomycin, as given for the treatment of gonorrhœa, have no effect on the dark-field positive lesions of early syphilis[5], the larger doses given for chancroid, in which condition it is very successful, may do so[6]. Streptomycin may, therefore, be reserved for sulphonamide-resistant cases and aureomycin for streptomycin-resistant cases.

Gonorrhœa

All three of the antibiotics given orally are capable of curing gonorrhœa, although their action is less certain than that either of penicillin or streptomycin given by the parenteral route. Likewise all are anti-syphilitic, and, as with treatment with parenteral penicillin, a follow-up of six months is necessary.

87 per cent of 122 cases of gonorrhœa given 1·0–3·5 gm. of aureomycin orally were considered cured by Collins *et al.*[7]. Previously Finland *et al.*[8] claimed 49 out of 66 cured, and Willcox and Findlay[6] had success with two cases. Willcox[9] likewise had success with two cases treated with chloramphenicol, as did Greenblatt *et al.*[4] on a larger if still small series.

With oral penicillin Jacoby and Ollswang[10], employing 400,000–600,000 units in buffered tablets, had 223 cures out of 270 treated males and 18 cures in 23 females. Such a method has been under trial for some years; but the dangers of self-medication and under-treatment cannot be overlooked. It has recently been applied to the U.S. Navy as a prophylactic. Campbell *et al.*[11] found, by giving 200,000 units orally fifteen hours after exposure, that the incidence of gonorrhœa could be reduced by half. Eagle *et al.*[12] divided 350 sailors into two groups. On return from a 6–8 hour shore leave half were given 100,000 units in a buffered tablet and the remainder acted as controls. In twenty-four weeks there were 43 cases of gonorrhœa in the controls but only five cases in sixteen weeks in the treated group. The dose was then increased to 250,000 units and, in the next eight weeks, only one additional case was reported.

Granuloma inguinale

4,000 mgm. of aureomycin personally given to four patients over five days was not sufficient, for two cases relapsed[13]. Greenblatt *et al.*, who in 1948 recommended a dose of 5,000 mgm. over five days[14], increased this in 1949 to 20 gm. given over ten days and had satisfactory results in 16 cases treated[15]. There seems to be some difference of opinion, however, as to whether aureomycin is effective for granuloma inguinale when given intramuscularly. Greenblatt *et al.*[14] say no and Wright *et al.*[16] yes. Robinson *et al.*[17] found it a less satisfactory drug than streptomycin, although Greenblatt *et al.* found it efficient for streptomycin-resistant cases[14].

With chloramphenicol Willcox[9] had temporary success with one case, and Greenblatt *et al.*[4], giving 500 mgm. six-hourly, treated 34 patients with only two relapses. Thus, whatever the outcome of this early work, it will be noted that both these newer antibiotics have the power to reinforce streptomycin, which has already wrought such a dramatic change in the treatment of this erstwhile distressing condition which does not respond to penicillin and but tardily to the antimonials.

Lymphogranuloma venereum

Although this condition is to some extent influenced by penicillin[18], this influence is reduced if the oral route is employed, and such is not recommended. Aureomycin was reported as effective by Wright *et al.*[16,18], who had considerable success in 35 patients treated. I used it on one case in Southern Rhodesia, a native with large bilateral, tender, non-fluctuant buboes and slight œdema of penis and scrotum but in whom the Wassermann and Kahn tests were negative; there were no genital sores. The Lygranum skin test was positive and the Dmelcos test negative. He was given 250 mgm. aureomycin orally three times daily for two days and then twice daily for three days (total 3,000 mgm.). By the fourth day the œdema had disappeared, and by the fifth day the glands were no longer tender and the patient was discharged from hospital.

Robinson *et al.*[20], however, state that when aureomycin was administered intramuscularly in doses of 0·56–3·6 gm. over 4–15 days, or orally as 3·6–38 gm. over 5–15 days, there were disappointing results in nine patients. Greenblatt *et al.*[4] likewise had only four cures in 13 early cases treated, but in late cases with proctitis some benefit was noted if the treatment was continued for 37–60 days. The same authors found chloromycetin inferior to aureomycin in eleven cases treated, and it seems likely, therefore, as in the treatment of chancroid, that the sulphonamides should have first place in this condition also.

Non-Specific Urethritis

Penicillin, given orally or otherwise, is relatively ineffective, and sulphonamides remained the drugs of choice until streptomycin became available, and this drug is producing fair results. Aureomycin, however, also has some action. Finland *et al.*[8] treated two persons successfully with 9 and 11 gm. respectively. Willcox and Findlay[6] treated four patients with 1–2 gm. over 1–2½ days with response in three, one of which relapsed but responded to retreatment.

Syphilis

O'Leary *et al.*[21] had healing of lesions in two patients with early syphilis given 44·2 and 67·5 gm. of aureomycin orally. The same authors[22] also noted involution of nodulo-ulcerative gummata in two other patients. Irgang and Alexander[23], giving 1 gm. intramuscularly for 20–23 days, and Willcox[5], employing relatively small doses of 750–1,500 mgm. orally over 24–48 hours, observed the abolition of *T. pallidum* from the dark field and the rapid healing of lesions in nine patients. That aureomycin has some action upon syphilis is undoubted, although Moore[24] considers it inferior to penicillin.

Employing chloramphenicol, Robinson *et al.*[25] found that *T. pallidum* disappeared from the lesions of primary and secondary syphilis in an average of 33·4 hours when 1 gm. was given six-hourly to a total of 40 gm. Two patients observed for more than a month became sero-negative. Romansky *et al.*[26] treated 32 patients with early syphilis with 8–56 gm. of chloramphenicol divided into four-hourly doses over 4–6 days. The dark fields became negative in 22–28 hours and the healing of lesions was prompt. Only two had been observed for two post-treatment months; but three had reached sero-negativity and others were improving. Of four Bantu Negroes

personally treated with 1·75–3·0 gm. given orally, the lesions healed in an average of 6·25 days with a rapid disappearance of treponemata[9].

Oral penicillin has, from time to time, been used experimentally for syphilis. The dose necessary is certainly extravagant, and the inconsistencies of absorption render such a method too risky for a serious disease like syphilis, and the parenteral route should be adopted. However, it has some indications, as for weakly babies with infantile congenital syphilis, until such a time as a more robust treatment can be instituted, and for rare cases as hæmophiliacs in whom needle puncture is contra-indicated. Buerk and Tucker[27] treated one such orally with 48 mega units.

Choice of Drugs

Under present conditions of knowledge, and granting that all are readily available, the drugs of choice for the different venereal diseases would appear to be as follows: the second drug listed to be used for persons failing to respond to the first.

Disease	First	Second
Chancroid	Sulphonamides	Streptomycin
Gonorrhœa	Systemic penicillin	Streptomycin
	Streptomycin	Systemic penicillin
Granuloma inguinale	Streptomycin	Aureomycin
Lymphogranuloma venereum	Sulphonamides	Aureomycin
Non-specific urethritis	Streptomycin	Aureomycin
Syphilis	Systemic penicillin	More penicillin

Thus, at present, the newer oral antibiotics are second-choice drugs. It is probable, however, on account of their multi-natured action, that they possess enormous prophylactic potentialities which will, doubtless, in due course be explored.

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ROLE OF TRYPTOPHANE AND OTHER AMINO-ACIDS IN THE METABOLISM OF NICOTINIC ACID BY HUMANS

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ALTHOUGH an increased urinary output of N-methylnicotinamide has been observed after ingestion of tryptophane by the rat[1], and also by humans[2,3], the rate of excretion does not appear to have been studied closely. Ling *et al.*[4] have, however, reported that the total pyridinenucleotide content of the erythrocytes of rats increased as early as four hours after intravenous injection of tryptophane, and reached a peak after eight to ten hours.

We have recently determined the rates of excretion of N-methylnicotinamide and N-methyl-2-pyridone-5-carboxylamide by an adult male European of thirty-four years during eight successive 3-hour periods after the ingestion of 3 gm. l-tryptophane, and have compared the results with those obtained in similar experiments on the same subject after no treatment (control experiment), or after ingestion of 100 mgm. nicotinamide or 100 mgm. nicotinic acid. In each experiment (except the control), the dose was taken at 7 a.m. as an aqueous solution, and urine specimens were collected at 3-hour intervals thereafter. The subject consumed his customary diet, which was kept reasonably constant, although the food was not weighed out; meals were taken at 7.30 a.m., 1.30 p.m., 7.15 p.m. and 9 p.m. The experiments were carried out on four consecutive Tuesdays, in the order shown in Table 1. N-methylnicotinamide was determined by the method of Huff and Perlzweig[5], and N-methyl-2-pyridone-5-carboxylamide by that of Holman and de Lange[6].

The results of the control experiment show that there was no great variability in the rate of excretion of either metabolite during the course of the day, and that the excretion of pyridone was more constant than that of N-methylnicotinamide.

After ingestion of l-tryptophane, the rates of excretion of both metabolites were higher in all eight periods than in the corresponding control periods. The conversion of tryptophane to nicotinic acid therefore appears to have commenced within three hours after the dose. Since the subject had received a dose of nicotinamide in the interval between the control and tryptophane experiments, the results were checked by repeating the experiment on the same subject four months later, the subject having received no treatment with nicotinic acid derivatives in the meantime, and the tryptophane being given on the day following the control experiment. Similar results were obtained, but the increase in the rates of excretion of both metabolites was not so pronounced in the first 3-hr. period.

The experiment was also carried out on another subject (a female of thirty-six years) who had previously received no extra-dietary supplies of nicotinic acid. In this case the rates of excretion of both metabolites were increased in the first 3-hour period; but the increase in pyridone was relatively small (N-methylnicotinamide increased from 0·15 to 0·38 mgm./hr. · N-methyl-2-pyridone-5-carboxylamide

Table 1. *NMN* = N-methylnicotinamide; *P* = N-methyl-2-pyridone-5-carboxylamide

Experiment	Metabolite of nicotinic acid	Average rate of urinary excretion of metabolite (mgm./hr.) in 3-hr. period No. 1	2	3	4	5	6	7	8
Control	*NMN*	0·33	0·26	0·32	0·22	0·28	0·15	0·26	0·29
	P	0·57	0·60	0·58	0·61	0·67	0·61	0·48	0·61
Nicotinamide (100 mgm.)	*NMN*	5·7	1·9	1·05	0·48	0·38	0·33	0·45	0·43
	P	4·6	5·1	3·9	3·4	2·9	2·27	1·67	1·60
l-Tryptophane (3 gm.)	*NMN*	0·45	0·57	0·42	0·40	0·30	0·20	0·34	0·36
	P	0·97	1·23	1·65	1·29	1·53	1·35	1·10	1·16
Nicotinic acid (100 mgm.)	*NMN*	1·06	1·12	0·58	0·56	0·53	0·48	0·60	0·54
	P	1·37	2·11	1·90	2·04	1·92	1·53	1·36	1·27

from 0·21 to 0·29 mgm./hr.). In the case of a third subject (a male of twenty-eight years), who had received 100 mgm. nicotinamide a week before the experiment, there was a slight increase in the rate of excretion of N-methylnicotinamide in the first 3-hour period (from 0·21 to 0·33 mgm./hr.), but none in that of the pyridone. The second and third subjects showed large increases in the rates of excretion of both metabolites in the second 3-hr. period after tryptophane. These results indicate that there may be appreciable variability between apparently healthy individuals in the rapidity of conversion of tryptophane to metabolites of nicotinic acid.

In general, however, the results for the three subjects show that the rate of excretion of at least one metabolite was increased, in some cases considerably, within three hours after ingestion of tryptophane, suggesting that the process occurs, at least initially, in the tissues and not through the agency of the intestinal flora.

Further examination of Table 1 shows that the rates of excretion of the urinary metabolites of nicotinic acid in the first four, compared with those in the last four, periods were much higher after nicotinamide than after nicotinic acid or tryptophane. This suggests that, if all three compounds are equally readily absorbed, the amidation of nicotinic acid is an important factor controlling the production of metabolites of nicotinic acid from tryptophane.

It seemed of interest to study the effect of amino-acids other than tryptophane on the metabolism of nicotinic acid by humans. Considerable evidence is available[7–11] that the growth-rate of rats receiving a diet low in casein and deficient in nicotinic acid may be suppressed by the addition of proteins or protein hydrolysates containing little or no tryptophane, or by mixtures of pure amino-acids. No corresponding depression of the urinary excretion of N-methylnicotinamide was, however, observed[9,10]. The growth suppression could be remedied by the addition to the diet of nicotinic acid or tryptophane.

We have determined the urinary excretions of N-methylnicotinamide and N-methyl-2-pyridone-5-carboxylamide by humans before and after the ingestion of a relatively large dose of a tryptophane-free protein hydrolysate. Two healthy adult European subjects (No. 1 a female aged thirty-six years, No. 2 a male of thirty-four years) were given a constant diet consisting of everyday foods, of similar composition to that described in an earlier experiment[12]. The urinary excretions of the metabolites of nicotinic acid were determined in three consecutive 48-hour control periods. At the commencement of the next (fourth) 48-hour period each subject was given a supplement of 100 gm. of acid-hydrolysed casein ('Difco' casamino-acids). Analysis of the hydrolysate showed that it contained only traces of nicotinic acid and tryptophane (nicotinic acid 0·6 mgm./100 gm.; tryptophane 7 mgm./100 gm. by the method of Millon[13], 75 mgm./100 gm. by the method of Folin[14]; NaCl, 13·4 per cent; total N, 10·9 per cent). The dose was taken in aqueous solution at intervals over a period of several hours. The levels of excretion of N-methylnicotinamide and N-methyl-2-pyridone-5-carboxylamide were determined during the fourth, fifth and sixth 48-hour periods. The results are shown in Table 2.

Table 2. *NMN* = N-methylnicotinamide; *P* = N-methyl-2-pyridone-5-carboxylamide

Subject No.	Metabolite of nicotinic acid	Urinary excretion (mgm.) of metabolite of nicotinic acid in 48-hour period No. 1	2	3	4	5	6
1	*NMN*	8·2	6·9	7·2	6·4	8·8	5·1
	P	13·9	12·2	12·6	9·0	16·6	10·7
2	*NMN*	15·5	14·2	15·0	13·0	10·5	16·9
	P	34·3	34·1	33·8	29·4	30·1	36·3

It is clear that no increase in the levels of excretion of the metabolites of nicotinic acid occurred after the dose, indicating that acid-hydrolysed casein contains no amino-acid which has any important effect in increasing the body's supplies of nicotinic acid. There was, in fact, a slight, but consistent, fall in the levels of excretion in the fourth period, suggesting that the amino-acids may have had a suppressing effect on nicotinic acid metabolism.

However, the alternative possibility, namely, interference with absorption or with intestinal biosynthesis of nicotinic acid, cannot be excluded, because of the nauseating nature of the dose of amino-acids and its possible disturbance of the normal gastro-intestinal rhythm. The whole dose was ingested by each subject, however, in addition to the basal diet.

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FIFTIETH ANNIVERSARY CELEBRATIONS OF THE DISCOVERY OF RADIUM

THE fiftieth anniversary of the discovery of radium was celebrated, albeit two years late, by a series of meetings held at the École Supérieure de Physique et de Chimie de la Ville de Paris during July 16–20. The delay, engendered by post-war difficulties, was more than excused by the successful conduct of the occasion and the liberality of the hospitality extended to the wide circle of foreign men of science who were present.

The celebration began with a ceremony on July 16 at which Prof. L. de Broglie presided, attended on either side by the Curies' daughters, Irene and Eve. The audience was welcomed by the director of the college, Prof. R. Lucas, who paid tribute to the part played in the organisation of the function by M. G. Boreau, the president of the association of old students of the college, and by Prof. G. Champetier. Prof. de Broglie reviewed the scientific achievements of the Curie family, beginning with the earlier successes of Pierre Curie in the fields of piezo-electricity, the theory of crystal symmetry and of magnetism. The brilliantly successful, but all too short, period of collaboration with the Polish student, Marie Sklodowska, whom he married, was recalled, and the subsequent development of the science of radioactivity and the part played by their daughter Irene was briefly narrated. Prof. F. A. Paneth replied for the visitors, analysing the historical aspects of the discovery. M. Boreau, a student of the college during the years 1897–1900, welcomed delegates from scientific societies from all over the world and announced the receipt of telegrams from many others. Speeches were also delivered by Mme. Ferragi (Institut du Radium, Paris) and Prof. G. Champetier (Ecole Supérieure de Physique et de Chimie).

Following the ceremony, the audience attended the unveiling of a plaque, commemorating the discovery of radium by Pierre and Marie Curie with the assistance of Gustave Bemont, that had been affixed to the entrance to the college.

The delegates were entertained to a dinner on July 18, held on the first platform of the Eiffel Tower, and on the morning of July 20 many of them visited the laboratories of the Commissariat à l'Energie Atomique, which are at Fort Chatillon, just south of Paris.

The opening ceremony was followed by three colloquia, each lasting a day, during July 17–19. The first dealt with the formation of ions, excited molecules and radicals in liquids by ionizing radiations and with their distribution. F. A. Paneth (Durham) described work in progress in his laboratory on a new determination of the curie by measurement of the volume of helium formed in a measured time by a measured mass of radium in an aqueous solution of a radium salt. Lauriston Taylor (National Bureau of Standards, United States) reported some recent investigations with carbon disulphide, ligroin and other liquid-filled ionization chambers. L. H. Gray (London Hospital) reviewed the columnar theory of ionization, and, by the combination of this hypothesis with the free-radical hypothesis of indirect action in irradiated aqueous solutions, he drew conclusions as to the distribution and concentration of the radicals and the hydrogen and hydroxyl ions in irradiated aqueous solutions. Another aspect of this problem was considered by F. S. Dainton (Cambridge), who showed how the kinetics of polymerization, induced by the irradiation of aqueous solutions of a monomer, will distinguish between uniform and non-uniform radical distribution. The session was concluded by a report of P. Jordan (Zurich) on the effects of mechanical recoil, following various neutron-induced nuclear reactions, when the irradiated material is in finely powdered form.

The second symposium was focused on the protection afforded by competitive reactions in irradiated media. N. L. Whitehead, C. Goodman and J. A. Breger (Massachusetts Institute of Technology), in a paper presented by the last-named author, discussed the decomposition of films of the fatty acids by the alpha-particles from radon and its relation to chain-length; the relevance of the investigation to the problem of the mode of formation of natural petroleum was briefly discussed. M. Burton described some results obtained in collaboration with S. Gordon and R. R. Hentz (University of Notre Dame, Indiana), concerning the effect of alkyl substitution on the decomposition of benzene derivatives by X-radiation. A. Nightingale (Guy's Hospital, London) presented some preliminary results obtained by C. B. Allsopp (Guy's Hospital) on the X- and γ-irradiation of aqueous solutions of indole, and C. H. Collie and P. Shaw (Oxford) described the precautions necessary for the successful application of the Szilard–Chalmers concentration to the measurement of low neutron intensities by means of the alkyl halides. The morning session concluded with an analysis by W. Mund (Louvain) of the effects of ionizing radiations on the reaction between hydrogen and deuterium and the influence of foreign gases thereon.

The afternoon session was opened by a paper by M. Haissinsky and M. Lefort (Institut du Radium, Paris) on the effect of ionizing radiations on solutions of various oxidizing and reducing agents. Some effects in formic acid solution were described by A. H. W. Aten, jun. (Amsterdam), and J. Weiss (Durham) presented a variety of experimental results relating to effects in organic substances, particularly in aqueous solutions. F. H. Krenz (Edinburgh) discussed some theoretical aspects of the mechanism of indirect action in aqueous solutions. A. G. Maddock and J. H. Green (Cambridge) showed how the inefficiency of bond rupture following radiative thermal-neutron capture could be determined, and advanced a hypothesis explaining their results. The close analogy between the chemical effects of ionizing irradiations and ultrasonic irradiation of aqueous solutions was demonstrated by N. Miller (Edinburgh), and W. M. Dale (Manchester) emphasized the insufficiency of present physico-chemical hypotheses to explain the biochemical effect of ionizing radiation.

The third symposium concerned the production, prevention and recovery of radio-lesions. S. Rowlands (Edinburgh) described the irradiation of the stomach mucosa of dogs with phosphorus-32, and F. Ellis (London Hospital) compared the results of fractionation of X-irradiation of the skin. The mechanism of the action of ionizing radiations on yeast cells was examined by C. A. Tobias (Berkeley, California), and M. Lamarque (Montpellier) presented a study of the recovery of the eggs of the death's head moth following irradiation by X-rays. Z. M. Bacq, A. Herve and M. Betz (Liège) gave an account of the protective effect of sodium cyanide and azide.

The afternoon session opened with a paper by R. H. Mole (Atomic Energy Research Establish-

ment, Harwell) on the possibility of protection, by chemical means, from whole-body irradiation. G. Hevesy (Stockholm) described some applications of tracers to the study of radio-lesions, and A. Forsberg (Stockholm) followed with a tracer study of the problem of protection from X-radiation. E. Lorenz (Bethesda, United States) presented a hæmatological study of the recovery of guinea pigs following chronic exposure to γ-radiation. The session closed with some further consideration of the problem of protection by L. F. Nims (Upton, United States).

A. G. MADDOCK

SOUTH AFRICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ANNUAL CONGRESS

AS part of the diamond jubilee celebrations of the foundation of Salisbury, Southern Rhodesia, the 1950 congress of the South African Association for the Advancement of Science was held there, during July 3–7, in conjunction with the Rhodesia Scientific Association. The meeting was most successful, and was attended by more than one hundred visitors from the Union as well as by men of science from both the Rhodesias. The Sociedade de Estudos, Mozambique, was also represented. Visitors were well entertained by the town of Salisbury, by the Governor and by the Rhodesia Scientific Association, and a number of excursions were arranged covering most of the varied interests of those present at the congress.

In his presidential address to the Association, Prof. C. van Riet Lowe, director of the Union Archæological Survey, spoke on "Prehistory and the Humanities", making a plea for the wider teaching and study of prehistory as a means for emphasizing the essential unity of mankind and inducing a better appreciation of spiritual values.

The sectional address to Section A of the Association, by Mr. W. J. Jarvis, dealt with "Planning from a Multi-Racial Aspect" and considered some of the problems involved in integrating the native population into an introduced Western way of life. To Section B, Dr. A. M. Macgregor spoke on "The Primary Source of Gold", suggesting that gold mineralization is related to the intrusion of granitic material into basaltic rocks from which traces of gold are dissolved and concentrated. Dr. E. R. Roux spoke to Section C on "Interspecific Plant Hybrids" and cited examples of hybridization between apparently different genera which closer investigation shows might be merely very different adaptations; more studies on hybrids are needed. The address to Section D dealt with "Aspects of Museum Research", in which Mr. Reay H. N. Smithers, director of the National Museum, Bulawayo, showed the value of taxonomic studies in museums and urged the need for expansion of these services, which are basic to other biological researches. To Section E, Mr. Roger Summers, also of the National Museum, described "Iron Age Cultures in Southern Rhodesia", dealing particularly with the many ancient ruins and proposing a tentative chronology for them and for the Iron Age pottery found in the country.

Following the suggestion made by the United Nations Educational, Scientific and Cultural Organisation, a symposium was held on the theme of "Man's Use of Energy". An outstanding contribution was the first authoritative account of the plan to dam the waters of the Zambesi River at the Kareba Gorge, some two hundred miles below the Victoria Falls, and to set up power plants to develop about one million kVA. The dam would also make possible a big irrigation project.

Particular interest was aroused in the popular evening lecture—always a feature of the yearly congress—which this year was given by Dr. S. H. Skaife, of Cape Town, and included a colour film showing the activities of termites which he has kept for fifteen years in specially designed and constructed nests. The life-cycle of the insects was traced, and many new sidelights thrown on the totalitarian regime of these creatures, which were seen on the screen at very large magnifications.

THE NATURALIST IN THE FIELD TO-DAY

THE Nature Conservancy is now in being and is a potential check against the destruction of areas in Great Britain of special importance from the point of view of geological structure, vegetation or other wild life, or of scenic beauty. The widespread seizure of these areas for afforestation, agriculture, Service requirements, etc., makes it all the more imperative to preserve what is left. But reserves can never be administered effectively by remote committees—still less from a 'window in Whitehall'. The care and vigilance of local interests, and especially of local naturalists, is needed: How far are they competent to shoulder this responsibility? This question formed the subject of the presidential address by Dr. E. A. R. Ennion to the Conference of Delegates of Corresponding Societies at the recent meeting at Birmingham of the British Association.

Dr. Ennion, as warden of Flatford Mill Field Centre, has devoted the past five years to devising ways and means whereby the 'amateur naturalist', irrespective of age, sex, background or calling, can gain increasing competence in his or her special interests. The experimental stage is almost ended.

There has been a steady rise, growing steeper in post-war years, in the 'curve of opportunity' open to the amateur naturalist. Dr. Ennion discussed some of the contributory factors in turn: books and journals; natural history society reports; lectures, with the improved technique now offered by various visual aids; films; broadcasts. But all these have one fundamental weakness—the recording of someone else's triumphs and experiences. Only by personal exertions and discoveries is anyone really able to become a naturalist.

The opportunities for first-hand experience and guidance in field-work have increased considerably, although mainly for two groups: the university student, who has facilities especially for marine work at Plymouth, Millport, Port Erin, etc.; and the ornithologist, at any of the small coastal bird observatories, Skokholm, Lundy, Spurn Head, etc. A trend towards establishing inland stations is growing, too: Oxford at Wytham; Cambridge at Madingley; and the narrow boat *Beatrice* of the Severn Wildfowl Trust are instances in point.

Much still remains to be done in at least three directions: (*a*) provision for field-work other than marine (or freshwater) biology and ornithology; (*b*) ensuring effective linkages between the various branches; and (*c*) provision for the guidance and reception of the individual inexpert but potentially serious student.

Flatford Mill, where Dr. Ennion took his first students in May 1946, and the three other centres of the Council for the Promotion of Field Studies—Dale Fort, Juniper Hall and Malham Tarn—go part of the way towards filling these deficiencies. Each accepts between forty and fifty students a week from March to October (and a few in the winter) from universities, training colleges and schools all over Britain, together with a "fair leavening of independent naturalists and artists". Each is staffed by a warden and his assistant, who cover all branches between them, the warden also being responsible for the entire organisation of his centre—an exacting post but a very much alive and worthwhile one.

A thousand university students and five hundred older independent visitors come to these field centres in the course of the year, which leaves about four thousand vacancies, distributed between the four centres, for teachers, training-college students and sixth-form boys and girls, whose previous experience of field-work is very limited. Almost all of them need the full-time co-operation of the warden and his assistant. So there is very little chance of adequate help for the occasional student—"the one in every twenty-five or so who takes to field-work like a duck to water"—who would obviously respond keenly to individual attention.

But these occasional individuals are of prime importance: they are the amateur naturalists of the future. Dr. Ennion is leaving his post at Flatford Mill to establish a new station, the Farne Naturalists Trust, where it will be possible to welcome these students individually. Monks' House, south of Bamburgh and opposite the Farne Islands on the Northumberland coast, has been secured for this purpose. It is designed expressly for the amateur naturalist, more particularly perhaps for the ornithologist, although workers in many other branches will find ample opportunity and a ready welcome. Monks' House opens next Easter, and details will be available shortly for those who are interested in this new development.

NEW ZEALAND EARTHQUAKES DURING 1947–48 AND JULY–DECEMBER 1949

R. C. HAYES has examined and catalogued all earthquakes in New Zealand during 1947[1] and also 1948[2]. In 1947 the earthquakes of June 16, from lat. 38·4° S., long. 178·4° E., and of October 13, lat. 44·2° S., long. 169·0° E., attained intensity 7 on the Modified Mercalli scale, and six earthquakes attained intensity 6. The sea area between the two islands and its environs, and North Island east and north-east of the River Wanganui, had the majority of the epicentres. There were concentrations of epicentres to seaward off Gisborne, and in the Southern Alps west of Christchurch and north-east of Mount Aspiring; also a small group to seaward in the extreme south off Puysegur Point. Otherwise, throughout the year, there were very few earthquakes elsewhere.

In 1948, 127 earthquakes were reported as felt during the year. The largest disturbance occurred on May 23 in the Hanmer–Waiau region, when intensity 8 on the Modified Mercalli scale was reached. Some buildings in the epicentral region suffered structural damage, and minor activity continued at intervals for some months. Other strong shocks occurred on January 15 off the Manawatu coast, on June 19 off the west coast of the South Island, and in July in the Monowai region; the first two of these were widely felt.

Provisional seismological bulletins for July–December 1949 have been received from the Dominion Observatory, Wellington. They include readings from nine observatories, including Suva, Fiji, and a new station, Cobb, established on July 20, 1949, in lat. 41° 5′ S., long. 172° 44′ E., and equipped with a Wood–Anderson short-period seismograph east–west component. During the period 114 strong distant earthquakes were recorded, and 129 local shocks felt. Of shocks with instrumental magnitude 5 or greater which were felt, three were experienced in Opotiki, three in Tolaga Bay, one each in Wairoa and New Plymouth and several in Wellington.

[1] New Zealand Seismological Observatory Bulletin *S*-90 (1949).
[2] *ibid.*, *R*-34 (1949).

STANDARDS FOR TELEVISION SYSTEMS

ONE of the study groups of the International Consultative Committee on Radiocommunication (C.C.I.R.) has recently been exploring the possibility of obtaining international agreement on the standardization of some of the various technical factors which define the characteristics of a television system. A preliminary meeting was held at Zurich in July 1949, at which it was decided that, before meeting again in London in 1950, the study group should inspect the practice and present state of development of the existing television services in America and Europe (see *Nature*, **164**, 477; 1949).

This inspection was carried out by representatives of some sixteen national administrations and operating organisations, and started with a visit to the United States in March and April of this year. The programme comprised a series of visits in New York, Philadelphia and Washington, D.C., for the purpose of witnessing the present-day operation of the television services available in the eastern portion of the United States, the development and production of various types of television equipment, and particularly of observing demonstrations specially arranged to assist the study group in its work on standards for television. This was followed by visits to Paris and Eindhoven, where the arrangements and demonstrations were organised by the Radiodiffusion et Télévision Françaises and the N. V. Philips Gloeilampenfabrieken, respectively. Finally, in Great Britain the delegates visited various stations and establishments of the British Broadcasting Corporation and the General Post Office, and industrial laboratories and factories. In all cases, the visits and demonstrations were designed to show the present state of television development and the different aspects of the varied and detailed work which is necessary for the establishment and maintenance of a public television service.

This tour was followed by a meeting of the study group in London during May 8–12, at which the various aspects of television standardization were discussed with the view of facilitating the interchange of programmes between countries and of reducing to a minimum the possibility of interference between television transmissions in adjacent countries. It was concluded at this meeting that, while it would have been most desirable to achieve standardization on a world-wide basis on all the various characteristics which define a television system, this appears to be impossible because of the existence of public television services using different standards in several countries in which large numbers of receivers are already in the hands of the public. There was, however, unanimous agreement on the following points, which were recommended for approval by the next plenary assembly of the International Consultative Committee on Radiocommunication: (1) television systems should be capable of operating independently of the frequency of the power supply; (2) the aspect ratio of the picture should be 4 : 3; (3) line interlacing should be used in the ratio 2 : 1; (4) asymmetric side-band transmission should be adopted for the vision signal; and (5) there is no necessity to standardize the polarization of the radio transmission.

In addition to the above, the characteristics of the 405-, 525-, 625- and 819-line systems were examined in some detail; and, for the reasons already stated, the representatives of France, the United Kingdom and the United States confirmed the continued use of their present standards. The French and United Kingdom delegates maintained their previous proposal, made at Zurich, to consider the unification of the standards of the London and Paris television transmitters. At the same time, the representatives of Austria, Belgium, Denmark, Italy, the Netherlands, Sweden and Switzerland declared themselves in favour of the 625-line system, and addressed an appeal to their colleagues to reconsider the position. The meeting concluded by directing attention to a number of technical problems that need further study in connexion with the general subject of television standardization.

ZOOLOGY IN RELATION TO AGRICULTURE*

By Dr. D. STEWART MacLAGAN
West of Scotland Agricultural College, Glasgow

ZOOLOGY *in sensu stricto* is the science of animal-life; agricultural zoology deals with the application of zoological knowledge to the practice of farming. The prospective adviser or research worker in agricultural zoology must, therefore, have a comprehensive knowledge of the vast terrestrial fauna, and must also be sufficiently informed about agriculture to assess the potentialities of zoological discoveries in relation to farming practice. Reasoned conjecture is part of the stock-in-trade of the academic biologist (and is usually harmless); but the agricultural biologist must be more circumspect. As with other applied sciences, agricultural zoology is based on a tripod of supporting struts—education, research, and its application—and, from the teaching point of view, one should steer a course between pure academics and sheer utilitarianism.

Few people cannot be aroused to enthusiasm over some aspect of animal life, and the countryside abounds in a wealth of teaching material. In the past, there has been a tendency to lay undue emphasis on structural details, at the expense of the ecological approach to zoology; although for all but the specialist student the ecology of animals has usually a greater appeal, and is certainly of great value in linking up with other subjects. This implies greater attention to the study of animals as a product of their environment—the effects of climatic and edaphic factors, the significance of natural enemies and other natural factors of population control, the causes of animal plagues, and so on. Apart from the educational value of zoology there is an urgent need of obtaining a deeper insight into the role of animals in the economy of Nature, because of sheer economic necessity.

In Britain to-day, there are six million more people and three million fewer acres of good farmland than there were in 1914; which means that there is only about half an acre of productive land per person. Now, every piece of land has a series of practical ceilings of productivity which can be raised by reducing the effectiveness of limiting factors, such as herbage-eating rodents, beasts and birds of prey, plant-feeding insects, disease-carrying ticks, and parasitic worms of stock and crop. Since there are no large areas of land awaiting easy exploitation, an alternative means of alleviating the food situation is the intensification of production; but all forms of intensive culture favour the multiplication of pests and insect-borne diseases, as seen in the abundance of orchard, vegetable and glasshouse pests: eel-worms of potato, beet and oats, and virus diseases of plants.

Through the operation of numerous 'checks and balances', plants, plant-feeders, and their natural enemies exist in a state of fluctuating equilibrium—the balance of Nature—until man starts to cultivate the soil or heavily stocks the ground. Thereafter, the complex relationships which contribute to the balance are ruptured in varying degrees, with resultant increase of some species and reduction of others. Heavy stocking favours the spread of disease-causing parasites. Bare fallowing reduces the soil population, whereas continuous monoculture favours a dense and specialized fauna. Between these extremes, different rotations favour different pests; but, in general, the farmer has a powerful weapon for pest-control in the judicious choice of rotations.

In view of the causal relationships between pest-densities (population) and environmental conditions, the agricultural zoologist has a splendid opportunity of linking science with practice, and of simultaneously expounding many highly relevant biological themes, for example, the struggle for existence and the survival of the fittest, the reproductive potential of animals and the toll of the environment, predator-prey relationships, adaptive modifications of structure and function, hazards of the parasitic mode of life, etc. Surviving species have adjusted themselves, in the course of time, to their environment (including competition among themselves) and have become the warp and woof of an intricate pattern. Hence, to assess the true role of a species in the economy of Nature is an exacting task, requiring a fundamental knowledge of ecology in general.

* Substance of an address to a Conference on the Land and the School, arranged by the Association of Agriculture in conjunction with the University of Glasgow and the West of Scotland Agricultural College, July 11–14.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

O—H Absorption in Chelate Compounds

It is well known that many benzenoid compounds containing a COOH- or OH-group *ortho* to another group capable of forming an internal hydrogen bond do not exhibit the normal OH-band found in simple unassociated hydroxylic bodies. The nature of the OH-absorption in intramolecularly bonded substances has never been clearly demonstrated, although some isolated examples of interest have been given[1–5]. It is the purpose of the present communication to provide general ideas regarding the OH-absorption of some chelate bodies, based on new data, and also to point out a certain similarity with the double COOH-ring found in associated acids.

Fig. 1 shows the absorption spectra in the 3-μ region of some carboxylic acids and related substances in carbon tetrachloride solution. Where no concentration is given, the absorption is substantially independent of the strength of the solution.

The spectra of methyl benzoate and anisole are given to indicate the amount of absorption attributable to a phenyl group (3·20–3·38 μ) and to a methyl group (dominant bands close to 3·39 and 3·52 μ; cf. 3·376 and 3·482 μ in paraffins[6]).

Acetophenone and *o*-hydroxyacetophenone show a rather striking suppression of CH_3-absorption. This may be compared with the reduced intensity of absorption of CH_2 when adjacent to a C=C group in hydrocarbons[6].

Stearic acid and *m*-methoxybenzoic acid are normal and show the usual increase in strength of the monomeric OH-band as the solution is diluted. Very intense CH_2-bands at 3·417 and 3·503 μ are found for stearic acid (cf. 3·418 and 3·505 μ for paraffins[6]).

Salicylic acid is of considerable interest. Apart from the monomeric OH-absorption (from COOH only) at 2·83 μ, the intense absorption at longer wave-lengths is clearly the sum of two separate effects. The band at 3·1 μ, similar to that found in methyl salicylate[4], is independent of concentration and therefore arises from intramolecular bonding, whereas the broad absorption band extending from 3 μ to beyond 3·6 μ is sensitive to concentration changes and arises from double molecules, as with other carboxylic acids (cf. acetic acid[7]). That an equilibrium between single and double molecules of salicylic acid of the form $R.COOH + R.COOH \rightleftharpoons 2(R.COOH)$ really does exist can readily be deduced from intensity measurements obtainable from Fig. 1.

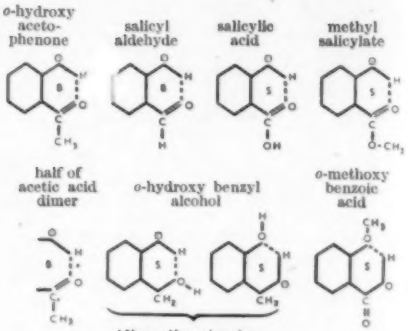


Fig. 2

Salicylaldehyde and *o*-hydroxyacetophenone both give broad bands extending from 2·8 μ to beyond 3·4 μ, but with a considerably smaller intensity than is given by carboxylic acids. Salicylaldehyde also has a sharp band at 3·521 μ attributable to the CH of the aldehyde group, and another small band at 3·641 μ of unknown origin.

o-Hydroxybenzyl alcohol has a sharp monomeric OH-band at 2·775 μ, as well as a fairly sharp band at 2·91 μ, due presumably to intramolecularly bonded OH, and somewhat similar to that found in *o*-methoxybenzoic acid[3]. The C_6H_4- and CH_2-groups absorb normally.

From these various spectra three facts regarding OH-absorption emerge: (1) carboxylic acids at a concentration of $M/50$ or higher are almost completely associated and have intense OH-absorption starting at 2·83 μ and extending well beyond 3·6 μ; (2) some hydroxylic bodies exemplified by salicylaldehyde and *o*-hydroxyacetophenone exhibit broad OH-bands as found in the acids, but with about one-fifth of the intensity of absorption; (3) other hydroxylic bodies also capable of intramolecular hydrogen bonding possess a fairly sharp OH-band at 2·9–3·1 μ, quite different from the absorption mentioned in (1) and (2). These results are summarized in Fig. 2, and it is immediately obvious that

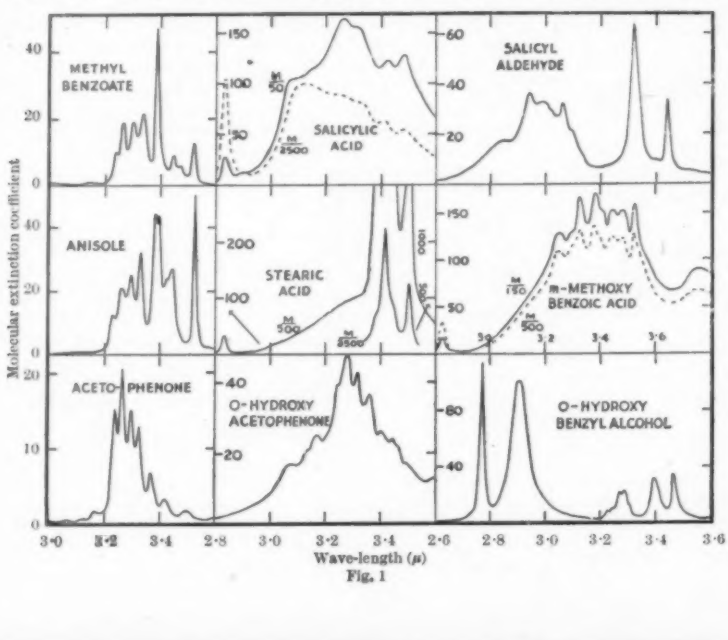
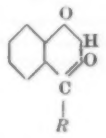


Fig. 1

a broad band is associated with the structure where R is H or CH_3, but a sharp band is produced when R is OH or $O.CH_3$. With *o*-methoxybenzoic acid and *o*-hydroxybenzyl alcohol, the C=O group in the ring containing the hydrogen bond is replaced by C—O, and a sharp band results.



It is of interest to note that one-half of the dimer of acetic acid (Fig. 2) is very similar to part of the ring containing the hydrogen bond in *o*-hydroxyacetophenone, and the OH-absorption is much the same in the two cases, although that of the carboxylic acid has about three times greater intensity.

A. E. Martin

Sir Howard Grubb, Parsons and Co.,
Optical Works, Walker Gate,
Newcastle upon Tyne 6. May 4.

[1] Buswell, Deitz and Rodebush, *J. Chem. Phys.*, **5**, 501, 726 (1937).
[2] Pauling, "The Nature of the Chemical Bond" (Cornell University Press, New York, 1939).
[3] Fox and Martin, *Nature*, **143**, 199 (1939).
[4] Fox and Martin, *Trans. Farad. Soc.*, **36**, 897 (1940).
[5] Davies, Ann. Rep. Chem. Soc., **43** (1946).
[6] Fox and Martin, *Proc. Roy. Soc.*, A, **175**, 208 (1940).
[7] Martin, *Nature*, **159**, 403 (1947).

Structure of Dimethyltriacetylene

Crystals of pure dimethyltriacetylene[1], $H_3C—C{\equiv}C—C{\equiv}C—C{\equiv}C—CH_3$, sealed in a Lindemann glass tube, are sufficiently stable at room temperature for detailed X-ray analysis. The crystal structure has the space-group $P\bar{3}m$ with one molecule in the rhombohedral unit cell. The centro-symmetrical molecule lies with its eight carbon atoms extended along the triad axis, and four parameters suffice to define their positions completely. These parameters have been determined by a Fourier synthesis of the $(h0\bar{h}l)$ structure factors; the atomic centres were located by the differential method with application of termination-of-series corrections[2]. The standard deviation of the bond-lengths is at present estimated to be 0·015 A., and it is hoped that further work now in progress may increase the accuracy of the analysis. The bond-lengths obtained are compared with those from related molecules in the accompanying table.

Bond-lengths in Acetylenic Molecules

Substance	$-C{\equiv}C-$	$-C{\equiv}C-C{\equiv}$	$C{\equiv}C-CH_3$	Method
Dimethyltriacetylene	1·19$_5$ A.	1·38$_6$ A.	1·46$_3$ A.	X-ray
Acetylene	1·204	—	—	Spect.[3]
Methylacetylene	—	—	1·462	Spect.[4]
Dimethyldiacetylene	1·20	1·38	1·47	Elect. diff.[5]
Diacetylene	1·19	1·36	—	Elect. diff.[5]
Diphenyldiacetylene	1·18	1·39	—	X-ray[6]
Diacetylenedicarboxylic acid	1·18$_4$	1·33	—	X-ray[7]

The triple bond-lengths in this table show very close agreement. The lengths of the conjugated single bonds, which are of particular interest because of their anomalous force constants in diacetylene and dimethyldiacetylene[8], appear to vary considerably, and unless this bond is unusually sensitive to environment our measurement is inconsistent with the value reported for diacetylene-dicarboxylic acid[7]. The value for the hyperconjugated single bond-lengths in the dimethyltriacetylene is the same within experimental error as the spectroscopic value for methylacetylene.

We wish to thank Prof. E. G. Cox for suggesting this investigation and providing the necessary facilities; we are indebted to Prof. E. R. H. Jones, Dr. M. C. Whiting and Mr. J. B. Armitage for supplying the material and advising us on handling it. We also wish to acknowledge a Ministry of Education grant to one of us (J. S. R.).

G. A. Jeffrey
J. S. Rollett

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May 11.

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[2] For details of the methods involved, see Cox, Gross and Jeffrey, *Acta Cryst.*, **2**, 351 (1949). Cox, Gillot and Jeffrey, *ibid.*, 356.
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Raman Effect of the Isomers of Benzene Hexachloride

In the course of our research programme on the structure of molecules, we have photographed the Raman lines of the pure alpha, beta, gamma and delta isomers of benzene hexachloride ($C_6H_6Cl_6$) dissolved in benzene. The lines were photographed with a Steinheil *GH* three-prism spectrograph specially fitted for Raman work (collimator, $f = 195$ mm.; camera, $f = 255$ mm.). The lines were excited by the mercury line 4358 A. by means of a Heræus No. *S*700 lamp.

The following Raman lines of the pure isomers were observed:

Alpha: 285, 310, 340, 400, 555, 655, 710, 795, 860 cm.$^{-1}$
Beta: 265, 305, 375, 390, 555, 670, 730, 855 cm.$^{-1}$
Gamma: 325, 345, 390, 485, 860, 690, 785, 890 cm.$^{-1}$
Delta: 300, 475, 555, 755, 790 cm.$^{-1}$

Of these the following frequencies were selected, the intensities of which were not influenced by the solvent: 710 (alpha), 730 (beta), 690 (gamma) and 475 cm.$^{-1}$ (delta), and were used for the determination of the isomer content of an industrial product. The intensities of these lines, which were measured on a Leeds and Northrup microphotometer, were compared with one another and with a suitable benzene line.

The preliminary experiments have shown that it is possible to estimate the isomer constitution of technical benzene hexachloride (with an accuracy of about ± 4 per cent) by means of the Raman effect.

A more complete description will be given elsewhere of the preparation of the pure isomers, the analysis procedure, the structure of the $C_6H_6Cl_6$ molecule and of a characteristic intensity and frequency change observed in mixtures.

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A New *Strychnos* Alkaloid

As part of a survey of the chemical constituents of the Australian flora, we have examined the alkaloids of *Strychnos psilosperma* F. Muell. Leaves collected at Dalmar, near Rockhampton, contained approximately 1 per cent total alkaloid from which a new alkaloid, now named 'strychnospermine', was readily isolated. It formed colourless needles of melting point 209°, had $[\alpha]_D + 58°$ ($c = 2{\cdot}07$ per cent in chloroform), and analyses of it, its bromo-derivative (m.p. 245°), its hydrochloride (m.p. 330–332° with decomp.) and its picrate (m.p. 254° with decomp.) indicated the formula $C_{21}H_{28}O_3N_2$. Tests for a methylene-dioxy group were negative, but one methoxyl and one methylimino group were present. When a small crystal of potassium dichromate was added to its solution in cold concentrated sulphuric acid, an intense permanganate colour was immediately produced. Treatment of the alkaloid with methyl iodide at room temperature readily gave a methiodide (m.p. 335° with decomp.), showing the presence of a tertiary nitrogen atom. Strychnospermine could not be hydrogenated in acetic acid solution in the presence of palladium charcoal. Hydrolysis with acid or alkali yielded deacetylstrychnospermine (m.p. 222°), which was smoothly reconverted to the parent alkaloid by acetic anhydride. The deacetyl derivative gave with nitrous acid a pale yellow crystalline nitroso compound (m.p. *c.* 195° with decomp.). The remaining oxygen atom is inert and is presumably in an ether linkage.

The evidence so far obtained, although slight, supports the hypothesis that strychnospermine is structurally related to the alkaloids of the strychnine group. Recently, Woodward[1] (cf. Goutarel[2] *et al.*) has advanced a theory of the biogenesis of these alkaloids, the application of which to strychnospermine leads to the deduction of the structural formulæ shown below.

The following points should be noted: (*a*) the rupture of the carbocyclic ring and the subsequent formation of the six-membered ether ring involve the loss of a carbon atom, whereas in strychnine a seven-membered ring is formed without the loss of a carbon atom; (*b*) at present formulæ *A* and *B* appear equally probable; (*c*) the reaction between the primary amino-group and formaldehyde (or its equivalent) leads to simple methylation and not to the formation of a new ring as in strychnine; (*d*) acetylation of the cyclic nitrogen atom is also simple, and again there is no subsequent formation of a new ring as in strychnine.

Work on the structure of strychnospermine is in progress, and it will be of interest to determine whether these predictions have any validity.

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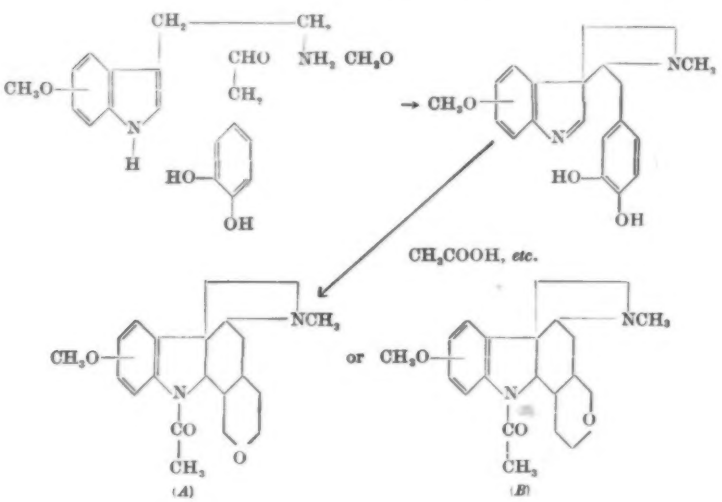
Filter-Paper Chromatography: Extraction of Sugars from the Paper at Room Temperature

In the procedure for the quantitative analysis of sugars, described by Flood, Hirst and Jones[1], the paper strips containing the sugars are cut out and extracted by allowing condensed water to run down the paper. It has been found, however, that destruction of certain sugars occurs on boiling a solution under these conditions. To obviate this difficulty, we have devised a technique of extraction at room temperature similar to that used by Dent[2] for amino-acids.

A chromatogram run with water as solvent indicated that the sugars travelled down the paper almost at the solvent front, and that the first few drops of eluate contained all the sugar from the paper strip. Similar results were obtained when water from a capillary was allowed to flow slowly down the paper (see below). On the other hand, however, it was found that if the rate of flow from the capillary were appreciably increased at the initial stage, there was risk of incomplete extraction due to channelling of the water flow.



The procedure finally adopted was as follows. The paper strip, pointed at the lower end to facilitate dropping, was held between two glass rods the interior surfaces of which were ground flat, and water was introduced to the top of the paper by means of a capillary dropping tube. This tube (capacity 10 c.c.; dropping-rate when full, 1 drop per 10 sec.) rested between the two supporting rods, touching the top of the paper. Water (1 c.c.) was added and allowed to flow down until the paper was completely wet; all the sugar is then at the foot of the strip. The dropper was then filled to the top and the flow continued for half an hour (total volume collected, *c.* 5 c.c.). This eluate contained all the sugar

from the strip, which could then be estimated by any of the usual methods[1,3,4].

Experiments with D-xylose, D-ribose, D-galactose, D-fructose, L-rhamnose and D-glucose gave theoretical results under these conditions. Estimation of the component sugars in a galactose – fructose mixture was effected by chromatography and subsequent treatment as above. This gave consistent results: galactose, 103 per cent; fructose, 102 per cent (estimation by the periodate method[4]).

Cold-water elution, therefore, affords a relatively rapid method for the complete extraction of filter-paper chromatograms under very mild conditions.

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Interrelationship between Natural Pigments and the Mechanism of Conversion of Carbohydrate into Fat

Participation of *Fusarium* pigments in the conversion of carbohydrate into fat was indicated when it was found that the greatest rise in fat production by *Fusarium solani* D_2 purple was paralleled by an increment in pigment formation; the fat content of *Fusarium lycopersici* obtained pigmented on Raulin–Thom medium increased with rising sugar concentration of the medium, while the reverse was true when the mould was grown unpigmented on Czapek-Dox medium; *Fusarium lini* Bolley grew unpigmented in both media and showed no change in fat content[1]. The function of these pigments was clearly indicated by experiments in which solanione was added to the media of growing *Fusaria*. The non-pigment formers produced a fat of greater desaturation under these conditions, whereas the fat formed in the pigmented moulds remained unaffected[2]. Evidence has been presented previously correlating the action of the fatty acid dehydrogenase system of *Fusaria*[3] with that of the pigments so characteristic of this genus. Increased desaturation of the fats of the non-pigmented *Fusarium lini* Bolley was also caused by naphthoquinones chemically related to solanione[4].

The effect of these pigments is interrelated with the action of the fatty acid dehydrogenase system, as can be seen from the fact that the vitamins riboflavin and nicotinic acid, which are known to be integral components of some dehydrogenase systems, produce the same effects as the pigments[5]. The rise in the unsaturation of the oils formed by the unpigmented *Fusarium lini* Bolley was attributed to augmentation in their content of linoleic acid. These vitamins did not affect the composition of the fat formed by pigmented *Fusarium lycopersici*; but the fat of the unpigmented variants of this mould showed the same change as was the case with the unpigmented *Fusarium lini* Bolley. Here the fat formed in the presence of the pigment lycopersin[6] is less desaturated and contains less linolenic acid than does that obtained from the unpigmented form.

Table 1. Effects of Riboflavin, Nicotinic Acid and Solanione on Fat Formation in *Fusarium lini* Bolley

Sample No.	Added substance (mgm./l.)	Mycelial weight (gm./l.)	Total lipide (%)	Iodine number	Riboflavin content (γ/gm. mycelium)
1	Control	5·50	8·55	111	31
2	0·800 *R*	5·37	6·88	157	32
3	0·500 *NA*	5·30	7·01	153	29
4	1·00 *S*	3·38	7·00	150	34

R, riboflavin; *NA*, nicotinic acid; *S*, solanione

Fusarium vasinfectum resembles *Fusarium lycopersici* in its general appearance. The pigment of the latter was isolated by a method similar to that employed for lycopersin[6]. The two substances displayed similar colour reactions with different alkalis, and their ultra-violet absorption spectra were identical. *Fusarium vasinfectum* usually grows with only slight pigmentation. However, when *i*-inositol is used as the carbon source in a Raulin–Thom medium, a fully pigmented mycelium is obtained when the initial *p*H is acid. On the other hand, a completely colourless mould results from an initially neutral or alkaline nutrient solution. The presence of lactose in the medium gives rise to the least amount of pigmentation when the initial *p*H is acid.

The role of lycopersin in the mechanism of the conversion of carbohydrate into fat can be seen from the results recorded in Table 2. Again, the presence of lycopersin is accompanied by the formation of a fat which is less desaturated than that formed in its absence. This change in unsaturation was found to be due to changes in linolenic acid content.

Table 2. Changes in the Composition of the Fat of *Fusarium vasinfectum*[*]

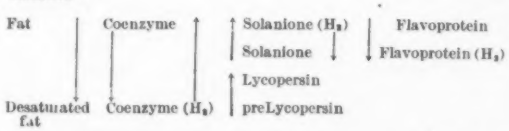
Sample No.	Carbon source	*p*H	Mycelial weight (gm./l.)	Total lipide (%)	Iodine number	Lycopersin content (mgm./gm. mycelium)
1	*i*-Inositol	3·3	6·08	19·8	104	3·48
2	*i*-Inositol	7·0	6·61	20·6	157	0
3	Lactose	3·3	7·45	17·6	133	1·32
4	Lactose	7·0	1·31	21·3	165	0

[*] The data recorded in this table were obtained by applying the methods used previously (refs. 2, 4, 5).

Further chemical studies on lycopersin indicate the absence of the quinoid nucleus, and the saturation of the pigment with respect to hydrogenation catalysts. This is in distinct contrast to solanione, which is reversibly reducible both *in vitro* and *in vivo*[7].

From these observations the possible mode of action of the fungal pigment may be considered as a participation in the transfer of hydrogen from the donor in part to a precursor of lycopersin. Due to the non-reversible reducibility of the latter, further transfer of hydrogen does not occur, as is the case with solanione. This static behaviour of lycopersin in the action of the fatty acid dehydrogenase system gives rise to a more saturated fat, whereas in its absence a fat of greater desaturation is formed.

The interactions are illustrated by the following scheme:



The above findings prove the interaction of these pigments in the course of action of the fatty acid dehydrogenases of *Fusaria*.

These studies were carried out under the auspices of the Office of Naval Research and were supported by a grant from the F. G. Cottrell Fund of the Research Corporation.

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Fermentation in the Rumen of the Sheep

In recent years it has become widely accepted that acetic, propionic and butyric acids are important products of the fermentation which takes place in the rumen; but as yet the information most cogent to the nutritional physiology of the ruminant, namely, the quantities of these nutrients which become available to the animal, has not been obtained.

When it was shown by Barcroft and his colleagues[1] that the volatile fatty acids are readily absorbed through the rumen wall, it became evident that an *in vitro* approach would be the one most likely to provide a solution to the problem.

We have set up, *in vitro*, fermentations of wheaten hay and of lucerne hay inoculated with micro-organisms from the rumen, and have found that when the inoculum was sufficiently large, and the conditions similar to those in the rumen, the extent to which the various carbohydrates in these substrates were fermented corresponded closely to the extent of their breakdown in the rumen. Moreover, the amounts of methane formed were of the same order as the amounts formed *in vivo*. Between 30 and 50 per cent of both the cellulose and hemicellulose fractions of the fodders were broken down, and 15–20 litres of methane per kilogram of fodder were produced within forty-eight hours. The quantities of each of the fatty acids formed are shown in Table 1.

Table 1. Fatty Acids Produced *in vitro*

Fodder	Acids (gm./kgm. fodder)			
	Acetic	Propionic	Butyric	Total
Wheaten hay	96	101	39	236
Lucerne hay	136	76	48	260

In Table 2 the differences between the composition of the mixture of acids formed *in vitro* and the composition of the mixture in the rumen fluid of animals fed on the same two fodders are shown. If the acids formed *in vitro* are indeed produced in the rumen, then these differences must throw some light on the problem of the relative rates of absorption of the acids through the rumen wall, for a comparison of the ratios of each pair of acids found *in vitro* and *in vivo* will indicate which acid is the more rapidly absorbed. For example, the ratio (acetic acid to propionic acid) in the case of wheaten hay fermented *in vitro* is $46/41 = 1{\cdot}1$, whereas the ratio in the rumen fluid is $71/17 = 4{\cdot}2$, indicating a more rapid absorption of propionic than acetic acid. From all of the data in the table, it may be concluded that when wheaten hay was fermented the relative rates of absorption of the acids fell in the series propionic > butyric > acetic, and in the case of lucerne hay the order was propionic > butyric ≈ acetic.

Table 2. Comparison between the Acids formed *in vitro* and those present in the Rumen Fluid

Fodder	Fermentation	Fatty acids*		
		% Acetic	% Propionic	% Butyric
Wheaten hay	*In vitro*	46	41	13
	In the rumen†	71	17	12
Lucerne hay	*In vitro*	59	27	14
	In the rumen†	70	14	16

* Molecular proportions.
† Averages from numerous analyses.

When these fodders are fed to sheep, it is found that the concentration of acid in the rumen rises sharply, and later falls again, reaching its original level within twenty-four hours. If, then, the acids are formed in the proportions which we have found *in vitro*, it is clear that certain changes in the composition of the rumen fluid must take place during the day. For example, the ratio of acetic to propionic acid should decrease immediately after feeding when the rate of production of acid is increasing; and it should increase again later, when production is decreasing or has ceased, because the effect of the different rates of absorption of the individual acids will then predominate. We have examined the composition of the rumen fluid at frequent intervals after feeding both these fodders, and have found that, in general, the predicted changes do take place.

Details of these experiments will be reported elsewhere.

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Isolation of Sodium Hyaluronate

During recent investigations for the development of new methods for the isolation and purification of hyaluronic acid from human umbilical cords, the following interesting observation was made. The cords, stored in acetone, were extracted with hot water (65°) and the aqueous extract allowed to 'settle' overnight. The clear supernatant liquid was kept under toluene for fourteen days, when it deposited a precipitate. This was removed, and the clear liquid was acidified with glacial acetic acid. Half the resulting mucin clot was stored in acetone for several weeks. Upon attempting to dissolve it at *p*H 8·0, it was found to be incompletely soluble, whereas the original clot was soluble. The 'acetone-clot' was extracted with water at *p*H 8·0, the extract giving only a very faint cloudiness upon acidification to *p*H 4·0. It was poured into 3 vol. of alcohol and the precipitate re-extracted with water. Finally, a preparation of sodium hyaluronate was obtained

having only 4·5 per cent nitrogen (on free acid) and 7·7 per cent ash (3·3 per cent sodium approximately); whereas the mucin clot, after reprecipitation, had 15 per cent nitrogen and negligible ash content. In fact, hyaluronic acid, containing only 6–10 per cent protein, had been extracted at *p*H 8·0 from the mucin clot after acetone treatment.

The hyaluronic acid (potassium salt) prepared from the mucin clot by repeated application of the Sevag procedure has a high ash content, namely, 20 per cent approximately, and 3·2 per cent nitrogen[1]. While the Sevag method is useful for removing small quantities of protein, it is laborious for larger quantities and rather cumbersome when used for a large-scale preparation. This new procedure is simple and easily worked on a large scale. The product may be treated, if desired, by the Sevag method to remove the last traces of protein.

Hitherto, most workers, in preparing hyaluronic acid, have aimed at reducing the nitrogen content as much as possible. However, it is feasible that protein may be attached to hyaluronic acid by linkages other than the usually assumed salt type, and which may be ruptured by prolonged Sevag-treatment at the usual *p*H 8·0. Consequently, it is possible that the present method of preparation might yield products of interest from this point of view.

Details of this and further work will be published at a later date.

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Use of Hyaluronidase in Microtechnique

The highly viscous cement or matrix of connective tissue consists of proteins and mucopolysaccharides, the latter containing hyaluronic acid (or acids)[1]. The viscosity of the matrix can be reduced by hyaluronidase (the spreading factor)[2] almost to that of water by depolymerization and hydrolysis of hyaluronic acid. McClean[3] showed that testicular extract containing the spreading factor allowed a more extensive spread of indian ink when injected into the dermis than did Ringer's solution. The extract produced a "swelling and splitting" of collagen fibres due to increased permeability of the fibre bundles rather than to any change in the collagen itself. Robb-Smith[4] also found that testicular hyaluronidase brought about separation of the reticulin network from muscle fibres, but had no histologically demonstrable effect on other parts of the fibre or its nuclei.

We have, therefore, used commercially available hyaluronidase to facilitate the diffusion of impregnating substances in skin. Post-mortem human skin was treated for one hour at 37° C. with a solution containing 10 µgm. of active freeze-dried testicular extract per ml. For complete penetration the strips of material should not exceed 2 mm. in thickness, and be freed of subcutaneous tissue. Carey's[5] modification of Ranvier's gold chloride technique was then applied, the epidermis removed by gentle shaking and the material dissected in glycerine using glass instruments. In this way it has been possible to demonstrate, without resorting to sectioning, the nerve plexus in the dermis, and the enervation and vascular supply of the dermal papillæ, among which a variety of encapsulated sense organs are to be found.

We have also used solutions of hyaluronidase in Ringer's solution to separate cells in the liver and in the snail's foot.

The method presents great advantages over the classical macerating agents, since it is rapid in action, causes a minimum of disturbance to cytoarchitecture and does not, so far as we can tell from oxygen uptake measurements on liver, result in the death of the cell.

Hyaluronidase is active over a wide range of *p*H and has an optimum round about *p*H 5·0 in solutions of buffer salts[3]. It is inactivated by temperatures above 60° C., and its activity falls rapidly at temperatures above 40° C. Dilute solutions can be stored for about a week at 4° C., provided they are not contaminated. Inhibitors to be avoided or carefully washed out of tissues before treatment with hyaluronidase are formaldehyde, iodine, sodium nitrite, ammonium sulphate, sodium sulphate and sterols[6]. Preparations mounted from water are very susceptible to infection, so that a suitable fungicide (cresol, phenylmercurinitrate, etc.) must be added to mount media.

Our thanks are due to Bengers, Ltd., who provided the sterile freeze-dried preparation of testicular hyaluronidase used in this work.

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Enzymic Formation of a New Riboflavin Derivative

Homogenates of rats' livers, and aqueous extracts of acetone powders of rats' livers, have been found to convert riboflavin into a flavin chromatographically different from riboflavin, flavin mononucleotide, and flavin adenine dinucleotide. The amount formed increases with time, and the conversion is accelerated by rise in temperature, but does not occur after heating at 100° C. The reaction is therefore thought to be enzymic. The flavin cannot be detected in unincubated homogenates which have been concentrated many times by Crammer's[1] method for extracting flavins.

Table of R_F Values

Solvent:	1	2	3	4	5
Riboflavin	0·30	0·46	0·18	0·47	0·25
Flavin mononucleotide	0·09	0·17	0·00	0·06	0·5
Flavin adenine dinucleotide	0·03	0·05	0·00	0·02	0·35
New flavin	0·20	0·36	0·09	0·23	0·4
Lumiflavin	0·40		0·28		
Lumichrome	0·70				

Solvent 1. 4/1/5 *n*-butanol/acetic acid/water.
" 2. 5/3/2 *n*-propanol/pyridine/water.
" 3. 2/2/1 *n*-butanol/*n*-propanol/water.
" 4. 3/1/1 benzyl alcohol/ethanol/water.
" 5. 5 per cent aqueous solution of Na_2HPO_4, $12H_2O$ (ascending chromatogram).

This flavin is not a photodecomposition product of riboflavin. Lumiflavin can be prepared from it, using Warburg's[2] conditions for prepering lumiflavin from riboflavin; this indicates that the modification has occurred in the ribityl side-chain, not in the

*iso*alloxazine part of the molecule. It has a partition coefficient of 0·54 between benzyl alcohol and water (compared with 3·2 for riboflavin, 0·010 for flavin mononucleotide and 0·004 for flavin adenine dinucleotide[3]), of which fact use is made during the isolation of the material. Comparison of the absorption spectra of riboflavin and of the flavin under investigation reveals no significant differences.

Recently a new flavin, flavin-X, has been reported in the literature[4], but the possibility that the flavin here described may be identical with flavin-X is eliminated by the fact that it does not contain phosphorus, whereas flavin-X is reported to be a flavin dinucleotide.

The possibility that this new flavin may be lyxoflavin[5] has not yet been excluded; it is, however, considered unlikely that so small a change in structure can account for so many differences in properties. Investigations are continuing on the nature of the compound, and they will be published in full elsewhere.

I am indebted to Dr. M. Dixon for his advice and encouragement, and to the Medical Research Council for a grant.

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Anticoagulant Activity of the Indian Cattle Leech

The anticoagulant activity of leeches has been known for a long time. Haycraft[1] obtained a saline extract of the anticoagulin from the head of a leech, and found that a dose of 0·01 mgm. would prevent the normal coagulation of 50 ml. blood for four and a half hours. Various investigators have since employed different techniques in their study of the anticoagulant action of leech extract. In our experiments with the common Indian cattle leech (*Hirudinaria*), an extract of the anticoagulant substance was prepared from the first eight segments of the body of the leech. The tissues were pounded with pure quartz sand in a mortar and the solution filtered through a cotton plug, freed from protein and buffered to *p*H 7·2 with Sørensen phosphate buffer.

Preliminary observations on the effect of freshly prepared extract were made on human and other mammalian blood *in vitro* and on white mice (weighing 60–100 gm.) *in vivo*. The coagulation time recorded in each experiment was much prolonged, and no case of hæmolysis of blood, as noticed by some previous investigators, was met. The extracted solution in most cases seemed to retain its anticoagulant property up to three weeks when stored at room temperature, with a maximum range between 95° and 100° F.

Furthermore, it was found that the fresh extract was absolutely non-toxic (unlike the one found by Marshall[2]) when administered to white mice by the intravenous, intramuscular or oral route.

There was a considerable increase in blood coagulation-time in white mice when freshly prepared extracts were administered by an intravenous or an oral route. The results of intramuscular injection in white mice were variable and require further elucidation.

The two important anticoagulants which have been used therapeutically are heparin and dicumarol. Whereas heparin is only effective when given intravenously, dicumarol is useful only when given orally. The extract from the Indian leech appears to act as an effective anticoagulant both by the intravenous and oral routes.

Further work is in progress to evaluate the comparative yield and the therapeutic anticoagulant effect of the extract from *Hirudinaria*.

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Dielectric Properties of the Human Body for Wave-lengths in the 1–10 cm. Range

A summary of the results of measurements of the dielectric properties of a representative selection of body tissues at a wave-length of 3·18 cm. has already been published[1]. These measurements have now been extended to two other wave-lengths, namely, 1·27 cm. and 10·0 cm., the method used being similar to that already described. All specimens, with the exception of bone, were taken from surgical operations, and measurements were made in each case with the minimum of delay and at a controlled temperature of 37·0 ± 0·5° C.

In Table 1, the results for these wave-lengths are tabulated, each being expressed in terms of an absorption constant (α) and a phase constant (β) for the tissue filling the aperture of a wave-guide appropriate to the wave-length used. The figures given are the average values obtained from two or more measurements on sections from one source, and the averages for sections from different sources are included, where possible, to indicate the variations encountered in practice. The measurement accuracies are estimated as ± 10 per cent in α and ± 5 per cent in β for 1·27-cm. wave-length and ± 5 per cent in α and ± 2 per cent in β for 10·0-cm. wave-length.

In Table 2, the real and imaginary components of the complex dielectric constant $\bar{\varepsilon} = \varepsilon' - j\varepsilon''$, calculated from the measured constants for a number of tissues, are compared at the three wave-lengths 10, 3·18 and 1·27 cm.

As with the 3·18 cm. wave-length, the measured constants for the two wave-lengths 1·27 and 10·0 cm. may be compared with those for water, the latter being present in a high percentage in all the tissues other than fat and bone. Determined in the same equipment, the constants for water at 37° C. were $\alpha = 12{\cdot}3$, $\beta = 34{\cdot}2$ for 1·27-cm. wave-length, and $\alpha = 0{\cdot}3$, $\beta = 5{\cdot}4$ for 10-cm. wave-length.

The general conclusions to be drawn from the measurements at the two wave-lengths are the same as those for 3·18-cm. wave-length, namely, that many of the body tissues behave very similarly to water in respect of their dielectric properties, that fat and bone, having much lower water contents, are relatively transparent to the radiation and that malignant and normal tissues do not differ significantly. One difference between tissue behaviour relative to water

Table 1

Specimen	$\lambda = 1{\cdot}27$ cm.		$\lambda = 10{\cdot}0$ cm.		Remarks
	α (nepers/cm.)	β (radians/cm.)	α (nepers/cm.)	β (radians/cm.)	
Whole blood	9·5	31·0	0·65	4·6	Uncoagulated by 1/500 mgm. heparin
	9·7	28·9			
Blood serum	10·3	34·7	0·84	5·3	Centrifuged specimen
Skin	6·4	23·2	0·81	4·1	Breast specimens free of areolar tissue
	6·3	25·4	0·65	4·5	
			0·73	4·6	
Fat	1·95	9·2	0·21	1·45	Breast specimens free of areolar tissue
	1·0	8·6	0·20	1·70	
	1·5	8·7			
	0·9	11·9			
Bone	0·95	11·7	—	—	Post-mortem specimens. Sections taken at different depths from the surface
	1·2	12·9			
	1·45	12·5			
Carcinoma of breast	8·1	28·6	0·73	4·8	All specimens confirmed scirrus carcinoma by histological examination
	6·9	25·2	0·60	5·0	

Table 2

Specimen	ε' (relative to air)			ε'' (relative to air)		
	10·0 cm.	3·18 cm.	1·27 cm.	10·0 cm.	3·18 cm.	1·27 cm.
Whole blood	53	45	32	15	23	20
Blood serum	70	57·5	45·5	22·5	24	29
Skin	43·5	35·5	23	16·5	16	13
Fat	6·9	4·5	3·4	1·6	0·95	1·1
Bone	—	7·6	6·3	—	1·45	1·1

at 10-cm. wave-length and at the shorter wave-lengths is that the absorption constant α tends to have a value approximately double that of water, indicating the significant contribution of the ionic conductivity absorption. Assuming equal contributions to total absorption at this wave-length by the polar water molecules and by ionic conductivity, a value of the order of 10^{-2} mhos per cm.[2] is obtained for the typical tissue conductivity, which is in agreement with the values obtained from measurements at longer wave-lengths (summarized by Osborne and Holmquest[2]). The ionic conductivity contributions to power absorption in such tissues at wave-lengths of 3·18 cm. and 1·27 cm. would appear, by similar calculation, to be about 10 per cent and 2 per cent respectively, and would not be immediately evident in the measured constants.

The assistance of Dr. N. A. Sharples in selection and preparation of specimens is gratefully acknowledged.

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A Reaction for the Study of the Kinetics of Electron Transfer

The isolation[1] of stable optical forms of the tris 2 : 2′ dipyridyl osmium II ion, $Os(dipy)_3^{++}$, and of the tris 2 : 2′ dipyridyl osmium III ion[2], $Os(dipy)_3^{+++}$, permits a unique demonstration of the dynamic electronic equilibrium between the oxidized and reduced forms of an ion. It is evident that when the *dextro* form of the osmium II complex ion is mixed with an equivalent amount of the *lævo* form of the osmium III complex ion, the optical activity of both ions should vanish if such an equilibrium exists.

$$\text{D } Os(dipy)_3^{++} \rightleftharpoons \text{D } Os(dipy)_3^{+++} + e'$$
$$\text{L } Os(dipy)_3^{+++} \rightleftharpoons \text{L } Os(dipy)_3^{++} - e'.$$

The experiment was carried out by mixing 10 mgm. of D,tris 2 : 2′ dipyridyl osmium II perchlorate with 10·9 mgm. of L,tris 2 : 2′ dipyridyl osmium III perchlorate in 20 ml. of water at 20° C. After two minutes, the osmium II complex was precipitated by the addition of 20 per cent sodium perchlorate solution, leaving a pink solution of the osmium III complex. Both the precipitate and the filtrate were found to be inactive.

Essentially the same experiment has been carried out in the studies of the ferrous/ferric and the tris ethylene diamine cobalt II/tris ethylene diamine cobalt III equilibria with radioactive iron[3] and cobalt[4]. However, the present experiment may also be used to determine the rate of electron transfer under varying conditions of temperature, concentration, and dielectric constant of the solvent without the necessity of altering the conditions by separation of the oxidant and the reductant.

Tris 2 : 2′ dipyridyl osmium II perchlorate has $[\alpha]^{25}_{5461} = 2200°$, while for tris 2 : 2′ dipyridyl osmium III perchlorate, $[\alpha]^{25}_{5461} = 200°$. The mixture of equivalent amounts of the D osmium II complex and L osmium III complex, at the instant of mixing, is therefore dextrorotatory, and the loss of activity consequent on electron transfer can be followed in a polarimeter. The intense green colour of the reduced form of the complex necessitated the use of very dilute solutions, and the maximum angle of rotation that could be comfortably observed was about 0·08°.

With the mixed solution 5×10^{-4} *M* with respect to both ions, the exchange was complete in less than 15 sec. at 25° C., but required approximately 65 sec. at 10° C. and 95 sec. at 5° C. The rate at 10° C. was very much greater in 2 *N* ammonium nitrate solution, but much slower in acetone, than in water. Both these effects are obviously related to the dielectric constant of the solution.

It is hoped to study quantitatively the effects of various factors, particularly concentration, with a photo-electric polarimeter.

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Lattice Constant of Grey Tin

THE crystal structure of α-tin (grey tin) is given by Bijl and Kolkineiger[1] as a diamond-type structure, having $a = 6{\cdot}46$ A., and the X-ray density as 5·81 gm.cm.$^{-3}$.

We have been supplied with a sample of grey tin prepared by Mr. J. T. Kendall of the City and Guilds College, London, and have measured its lattice spacing at room temperature. Nickel-filtered copper radiation was used. Assuming λ for copper $K\alpha_1 = 1{\cdot}54050$ A.[2], the lattice spacing in absolute angstrom units is $6{\cdot}4912 \pm 0{\cdot}0005$ A. The X-ray density, calculated from the formula[2] $\rho = 1{\cdot}66020\,\Sigma A/V$, is $\rho = 5{\cdot}765$ gm.cm.$^{-3}$.

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Graticules as Guides in Electron-Microscope Metallography

ONE of the greatest difficulties for the user of an electron microscope in metallography is the localization of a micrograph on the original specimen. The high magnification gives a very small area of observation which is, in general, less than $15\mu \times 20\mu$. It is, for example, only one three-thousandth of the area of a 1-mm.^{2} specimen, and it is therefore practically impossible to identify it again.

A method of solving the problem has been developed in this Laboratory. It consists in cutting a fine graticule on the polished metal surface. An ordinary diamond as used in optical microscopy is not suitable, however, because the finest lines which it can give are too coarse. This causes the replica film to break along the lines and, moreover, the lines themselves are too broad, so removing too great a part of the specimen.

We have developed an instrument, manufactured by LKB-Produkter, Ltd., at Stockholm, which enables us to scribe a metal surface with lines of width less than 2μ. The instrument stands on a microscope base. A diamond, suspended from an arm, can move over the specimen surface and is lifted from it on the return stroke. The cutting pressure, which is of the order of 0·01 newton, can be adjusted by means of a sliding weight. The limit of measurements is about $0{\cdot}2\mu$.

The replica is prepared in two stages with collodion and aluminium. To strengthen the aluminium film, we have used double evaporation, both at an angle of 10° to the normal of the surface, giving an angle between the two evaporation directions of 20°. The collodion is dissolved in amyl acetate and the freely floating aluminium specimen is picked up on the slide.

Localization is made easier if every line in the graticule is capable of individual identification. For these experiments we have chosen a master spacing of 50 μ, while the maximum number of lines in any one group is four. We have chosen different minor spacings in the horizontal and vertical direction, namely, 4 μ and 6 μ respectively.

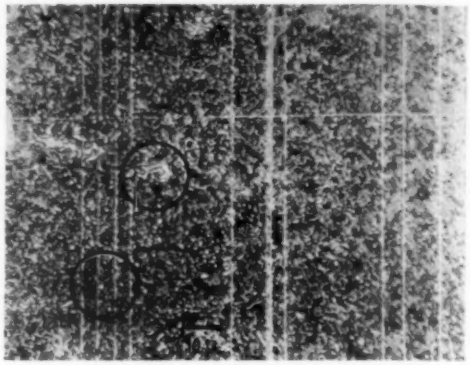

Fig. 1. Steel Sandviken 22*C*1, 1·1 : 1·2 % C, 0·5 % Cr; heat-treated for one hour at 780° C. (optical microscope, × 450)

No difficulty has been experienced due to the scribed lines being obscured by 'bars', since the geometrical regularity of the pattern renders the lines easily identified.

We have demonstrated the use of the instrument for the study of steel (Sandviken 22*C*1, 1·1 : 1·2 per cent carbon, 0·5 per cent chromium). The steel had been heat-treated for an hour at 780° C.

Fig. 1 shows part of the specimen with 450 magnification. One of the marked parts is shown in Fig. 2 with 4,500 magnification. The light spots are carbides, whereas the background is martensite.

A comparison of the electron micrographs and optical micrographs shows good similarity in all

Fig. 2. Part of Fig. 1 (electron microscope, × 4,500)

details, proving that the electron microscope can give reliable pictures.

With further development the instrument might be used as a microhardness tester. The breadth of the lines passing through different parts of the specimen can give an idea of the relative hardness of the grains.

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Viscosity of Metallic Liquids

THE viscosity of metallic liquids has been comparatively little studied, mainly due to the experimental difficulties characteristic of viscosity measurements at higher temperatures. The interest in viscosity data is, however, considerable. On the theoretical side, such data would provide further information towards the understanding of the liquid state, while, in the field of applied metallurgy, the viscous nature of liquids is tied closely with the flow behaviour of metals in filling moulds. The paucity of data in these fields can be appreciated from the fact that even such important problems as the variation of viscosity as a function of temperature close to the melting point of a metal, and the variation of viscosity as a function of composition in binary alloy systems, have not been fully studied experimentally.

Viscosity measurements which have been recently carried out in this Department show that certain views normally held on these points are not supported by experiments. For example, it is generally assumed[1] that the relationship of viscosity to temperature is given by :

$$\eta = A \exp B/RT,$$

and that this expression holds true to the melting point of the metal. The experimental results we have

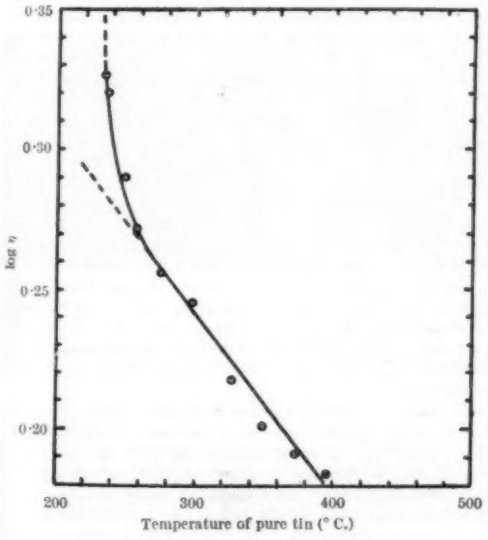

Fig. 1

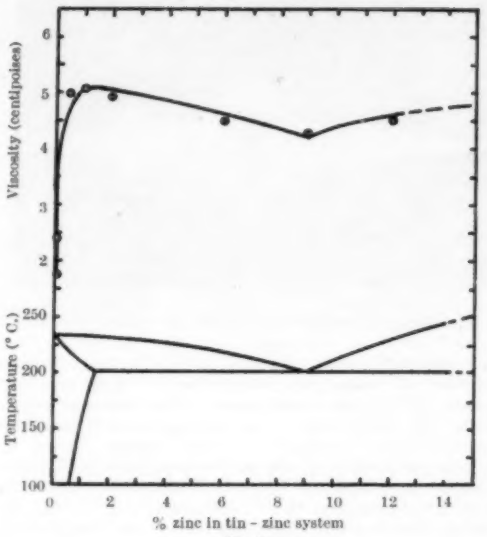

Fig. 2

obtained with tin, lead and certain binary alloys, however, show the relationship indicated in Fig. 1. It is clear that the absolute viscosity changes rather markedly a few degrees above the melting point.

On the question of the relation of viscosity to the composition of simple binary alloy systems, it is generally taken that viscosity is an additive property of the mixture of the two metals[2], and that deviations from this rule are only obtained in the presence of strong intermetallic compounds in the system. Our experimental results, which were carried out over a considerable range of temperature and composition, show, on the other hand, that the viscosity of simple systems, for example, tin–zinc, is represented by the relationship indicated in Fig. 2. It is interesting that such correlation of viscosity with constitution is only obtained when viscosity is plotted at a constant temperature above the liquidus for the system, rather than at a constant absolute temperature. A similar relationship was observed by Poliak[3] with aluminium–silicon alloys.

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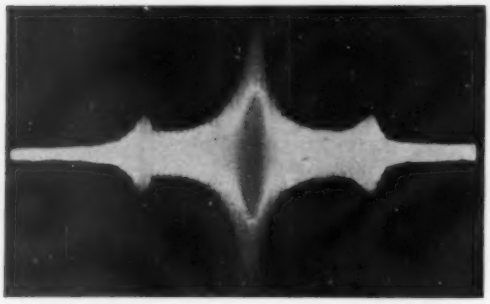
A Resonant Circuit with a Time-Variant Resistive Element

MUCH attention has been devoted to a study of the effects associated with periodic variation of inductive and capacitive elements (the energy-storage elements) of resonant circuits. The present communication is concerned with two closely related phenomena arising from periodic variation of the resistive element of a series or parallel circuit.



The first phenomenon is that of multiple resonance[1,2] and is illustrated in the accompanying oscillogram for a circuit tuned to 6 kc./s., the resistive element of which was being varied at 50 c./s. by means of a negative resistance. The abscissa represents the frequency of a driving E.M.F. and the ordinate the associated voltage (which varies in amplitude at 50 c./s.) across the main circuit capacitance; the average circuit resistance remained positive throughout the 50 c./s. variation. It can be shown that peak responses occur at frequencies $f_0 \pm nf_1$, where $f_0 = 1/2\pi\sqrt{LC} = 6 \times 10^3$ c./s., $f_1 = 50$ c./s. and $n = 1, 2, 3 \ldots$. The photograph shows only three such peaks, one below and one above f_0, but as many as six below and six above have been observed. The selectivity in the region of the central response increases with the amplitude of the resistance variation.

The second phenomenon is that of parametrically excited oscillations[3,4] resulting when the effective circuit resistance varies at a frequency $f_R \approx 2f_0$, and at the same time the resistance is allowed to become negative during part of its cyclic variation. Oscillations of substantially constant amplitude and purity of wave-form exactly half the frequency of the resistance variation $f_R/2$ occur over a range of frequencies near f_0. The range is limited by sharp cut-off of the self-oscillation, and this suggests the use of the device as a filter, particularly since the band-width is readily controlled.

The theoretical basis of these phenomena lies in Hill's equation[5]:

$$\ddot{y} + [a - 2q\,\psi(2z)]y = F(z),$$

where a and q are constants, and $\psi(2z)$ and $F(z)$ are periodic functions of time. Good quantitative agreement has been obtained between experiment and, on one hand, multiple resonance calculations from the particular integral solution, and on the other, calculation of the self-oscillation frequency and band-width obtained from the solution in the unstable $a - q$ region of the complementary function. Full particulars will be given in a later publication.

We are indebted to E. H. Ballantyne and L. S. Dektereff for assistance with the experimental work.

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An Improved Type of Wetted-Wall Column

Preliminary investigations, carried out in this Department, have shown that the efficiency of a wetted-wall column may be improved by subjecting the liquid and vapour phases to a rapidly oscillating pressure. This induces increased turbulence in the refluxing liquid, resulting in a larger surface area for mass transfer.

A wetted-wall column was attached, via the condenser, to a cylinder closed by a reciprocating piston. Pressure changes of the order of 15 per cent at a frequency of 20 cycles per second have resulted in an increased efficiency of approximately 50 per cent, expressed in terms of theoretical plates.

The efficiency of a column 'packed' with a gauze spiral may also be increased by this device, but to a lesser extent, dependent upon the packing density.

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Occurrence of a Network in the Excrement from the Larva of the Clothes Moth

As a detail in an investigation of the degradation products from enzymatic digestion of wool, excrement from the larva of the clothes moth (*Tineola biselliella* Hummel) have been subjected to examination in the electron microscope.

The pellets were ground in an agate mortar and suspended in water. A droplet of the suspension was placed on the collodion film, dried and shadow-cast with gold-manganin. The examination was carried out with an *RCA* microscope, type *EMU*.

Among various stages of disintegrated wool particles very regular networks were also observed, often covering areas with diameters up to more than 50 μ. Three different main types could be recognized. The first one (Fig. 1) is the regular 'fishing-net' pattern, constituted by threads or fibres running in three main directions, thus forming symmetrical meshes with a width of about 0·2 μ. These fibres are themselves bundles of fibrils, each of which has a thickness of 50–60 A. At the junctions it can be seen how the fibrils from different threads are plaited. The fibrils can also be observed in the places where the fibres are split up, for example, near the borders of the network. The regularity of the pattern is well preserved even near the border. The second type is shown in Fig. 2. Basically, it consists of the same network, which can be recognized on the photograph; but here the meshes are filled up with some substance so that a continuous background membrane is formed. The white formations are bigger, extraneous particles lying underneath the membrane. In the third type, shown in Fig. 3, the fibrils seem to be arbitrarily arranged and the regular pattern has been destroyed, at least partly. Parts of the network, forming stages between the first and third types, have also been observed.

It may be worth mentioning that these networks were very scarce if the specimen was prepared immediately after suspending the ground pellets in water. If, however, the same suspension was allowed to stand for about two days at room temperature, the networks were both bigger and more abundant. It seems probable that the network originates from the intestines of the moth larvæ, as we have also

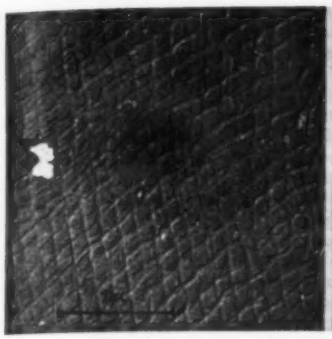

Fig. 1

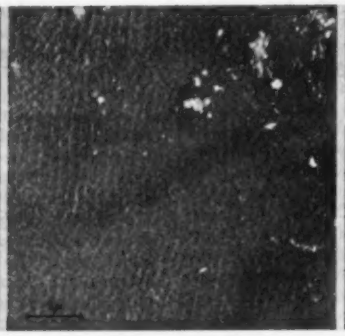

Fig. 2

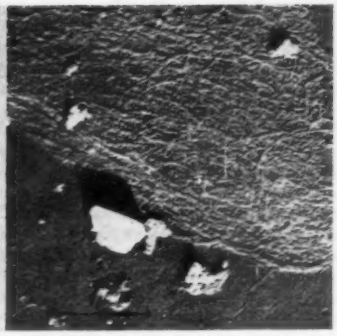

Fig. 3

Fig. 1. Regular network from the excrement of the larva of clothes moth. Shadowed with gold-manganin

Fig. 2. Continuous membrane in which the regular 'fishing-net' pattern can be recognized. Shadowed with gold-manganin

Fig. 3. Arbitrarily arranged fibrils. Shadowed with gold-manganin

found them in the excrement from larvæ fed on a diet free from wool. These networks seem to be similar to the structures in *Dixippus morosus* recently reported by Huber and Haasser[1].

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A Localized Effect of Light on the Protoplasmic Viscosity of Plant Cells

IF one half of a leaf of *Elodea densa* is illuminated, the other half being screened off, a decrease in the permeability strictly localized to the illuminated area is observed[1]. This area accumulates methylene blue considerably more strongly than the unilluminated area.

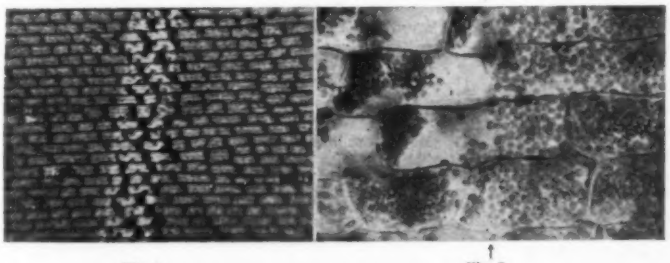

Fig. 1 Fig. 2

Fig. 1. A leaf of *Elodea densa* which has been illuminated through a small aperture in a piece of tinfoil and then centrifuged

Fig. 2. Some centrifuged cells of *Helodea densa* of which part has been illuminated. The illuminated area is seen to the left of the arrows

Illumination of cells with strong visible light (for example, 22,000 m.c. incandescent light) also causes an appreciable decrease in the viscosity of the plasma. This is demonstrable by the fact that the cell contents, such as the plasma with its component plastids, of cells which have been illuminated can be made to move considerably more easily under the influence of centrifugal force than those of unilluminated cells[2-5].

It has now been found that this decrease in the viscosity is strictly confined to that part of the leaf that has been illuminated. Thus, if a leaf of *Elodea* is covered with a strip of tinfoil in which a small aperture with even edges is cut, and the leaf is centrifuged after illumination, only that part of the leaf under the aperture in the tinfoil has been affected (Fig. 1). Closer examination of the cells adjacent to the edges of the aperture reveals occasional cells only part of which has been illuminated. It is found that the viscosity is decreased only in illuminated parts of the cells, the unilluminated parts being unaffected (Fig. 2). This is thus an example of a reaction in which the site of the perception of stimulus and of the reaction is the same.

It has been shown earlier[2-4] that changes in the viscosity of the plasma due to light constitute a reaction which is in all probability a general phenomenon. The above observations with respect to the localized effect of the light energy applied—which is evidently intimately connected with the changes in permeability—suggest an explanation of the phototropic phenomena in polar organs such as the coleoptile of *Avena*, which has a polar stream of hormones. Unilateral illumination of such an organ causes changes in the viscosity and the permeability respectively of the plasma in the cells treated. This may possibly be the reason for the unequal distribution of the stream of hormones originating in the tip of the organ.

Further details of these experiments with respect to the viscosity changes in illuminated plant cells will be published later.

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Malaria Eradication in Ceylon

ONE of the most important vectors of malaria in India, and the only vector so far reported in Ceylon, is *A. culicifacies*. Afridi and Puri[1] reviewed the available literature relating to this species in India. Covell[2] lists the countries where this mosquito has been found, its breeding places, adult habits and relation to malaria. In India, this is reported to be a domestic species. James and Gunasekera[3] were the first to find this species infected in Nature in Ceylon. Carter and Jacocks[4] confirmed these findings. During the various regional epidemics that occurred in Ceylon during and since 1934, this was the only anopheline species found infected with malarial parasites. According to Carter (unpublished reports), *A. culicifacies* in Ceylon is domestic in its habits and has been captured in dwellings and in human-baited traps. It breeds profusely in the sand pools and rock pools in the beds of streams and rivers. The breeding places so far described were in the close vicinity of human habitations.

A scheme of country-wide residual spraying of DDT was inaugurated in Ceylon in 1945, and during the past four years a remarkable reduction in malaria endemicity has been brought about. Encouraged by these results, the question of total eradication of the vector species on the lines of work undertaken in Brazil, Egypt, Cyprus and Sardinia was seriously contemplated. But considerable doubts about the feasibility of undertaking total eradication were entertained for various reasons, one of which was the possibility of *A. culicifacies* breeding in jungle areas away from all human habitation.

In a preliminary survey carried out in 1948 in connexion with the Gal Oya irrigation project in the dry zone (annual rainfall of 50–75 in. with practically no rains during eight months of the year), a jungle area on the eastern side of Ceylon, L. F. Gunaratne (unpublished report) had found the larvæ of *A. culicifacies* in sand pools in the bed of the Gal Oya at a distance of more than a mile from the nearest human habitation. Before total eradication was undertaken, it was considered necessary to carry out further investigations into the breeding of this species in the jungle areas.

Two areas, one in the north-west and the other in the south-east parts of Ceylon, were selected, and an intensive search was made both for adults and for larvæ in the available water collections. In the north-western area, the search was confined chiefly to the sand and rock pools in the beds of two perennial rivers, all other ground-water having practically dried up at the time the search was made. In the south-eastern area, besides two rivers, there were small collections of ground-water such as pools, channels, swamps and tanks, which were searched. Thatched huts, 15 ft. × 15 ft. × 8 ft., were erected in both areas close to the banks of these rivers, and captures of adults were made continuously throughout the night, using human bait.

In the north-western area, 6,250 yards of the margins of the two rivers yielded 2,572 anopheline larvæ, of which 295 (11·4 per cent) were *A. culicifacies*. In numerous disconnected sand and rock pools with a total area of 1,210 sq. yd. were found 9,968 anopheline larvæ, of which 3,831 (37·9 per cent) were *A. culicifacies*. The nearest human habitation was at a distance of two to five miles from these rivers, which flow through dense jungle in which there was scrub as well as high forest forming an impenetrable belt. A total of 247 anopheline adults, of which 123 (50·6 per cent) were *A. culicifacies*, were caught in 100 catching hours, some while in the act of feeding on human baits and others while resting on the thatch after the feed.

In the south-eastern area, 2,445 yards of river margins yielded 1,960 anopheline larvæ, of which only six (0·3 per cent) were *A. culicifacies*. Seventy sand and rock pools with a total surface area of 120 sq. yd. had 1,994 anopheline larvæ, of which 236 (11·9 per cent) were *A. culicifacies*. The nearest human habitations were at distances of four to seven miles from the sections of the rivers which were examined. Of the other collections of ground-water examined in this area, the only one which had a single larva of *A. culicifacies* was an earth channel taking off from a tank. Two catching stations, one at a distance of four miles from the nearest human habitations and the other at six miles, yielded 85 *A. culicifacies*, which is 87·6 per cent of a total of 97 adult anophelines caught in 40 catching hours.

There was no question of larval drift from upstream, for the pools which are the main breeding places were disconnected isolated pools. The adult-catching stations were put up in the midst of thick jungle into which adult *A. culicifacies* could not have been transported passively by vehicles, since no vehicles could be taken to these areas. Nor could they have infiltrated such long distances from the nearest villages through the thick belt of scrub and high forest. Further, a good many were freshly emerged adults with their wing markings intact. There is no reason to doubt that this species is breeding in the jungle at long distances away from human habitation. This finding is contrary to the views held hitherto that in Ceylon *A. culicifacies* is a domestic species living in close proximity to human habitation. In these circumstances, it is obvious that eradication of this species in Ceylon is not a practical proposition.

A detailed study of *A. culicifacies* in Ceylon will be reported elsewhere.

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Ceylon.
May 16.

[1] Afridi, M. K., and Puri, I. M., *J. Malaria Inst. India*, **3**, No. 1, 1 (1940).
[2] Covell, G., *J. Malaria Inst. India*, **5**, No. 4, 401 (1944).
[3] James, S. P., and Gunasekera, S. T., Sessional Paper 34 (1913).
[4] Carter, H. F., and Jacocks, W. P., *Ceylon J. Sci.*, D, **2**, Pt. 2, 67 (1929).

An Improved Method for Mounting Mosquito Larvæ

THE successful preparation of permanent mounts of mosquito larvæ has for long been an arduous and uncertain operation; mounts in balsam are time-consuming and frequently unsatisfactory, while mounts in chloral gum media do not keep well in some climates. The most recent advance is the medium of Bhatia[1], consisting of pine rosin in eucalyptus oil, which is simple to use and gives a fair result. However, comparative tests of this medium against another which I have recently developed

indicate that the latter gives an even more satisfactory result.

This new medium consists of a solution of Canada balsam in phenol (Phenol Liq. B.P.), prepared by heating the Canada balsam to drive off any water present, and adding phenol to the cooling mass until a satisfactory consistency is obtained. Larvæ are mounted direct from 95–100 per cent alcohol, the ventral surface of thorax and abdomen being first pierced in several places with a fine needle. Mounts clear rapidly and are sufficiently firm for use after several days in the sun.

A further refinement of the method, for use when perfectly cleared specimens are required for systematic research, etc., is to macerate specimens first in strong chloral hydrate solution (80 gm. in 20 c.c.) or 30 per cent acetic acid. Larvæ should be killed in hot water or other fixative and pierced with fine needles as above, and then placed in the chloral hydrate for twenty-four hours or more. They should then be washed in 90 per cent alcohol and given a short phenol bath prior to mounting in the phenol-balsam. As such specimens are very soft, the transfer to the slide should be made by pipette. Such mounts are perfectly transparent, being little more than larval skins, and are most useful where ventral hairs are to be examined. The method is, however, only applicable to fresh material; old specimens from alcohol fail to clear in chloral hydrate.

Bhatia's pine rosin has also been tested in phenol solution and gives a result equally as good as the balsam medium—sometimes a little better. But as the keeping qualities of the rosin have not yet been tested over a long period, I prefer to use balsam.

The above processes are presumably applicable to other small Arthropoda. A more detailed account is being prepared for publication elsewhere.

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May 10.

[1] Bhatia, M. L., *Ind. J. Malar.*, **2**, No. 4, 283 (1948): *Nature*, **164**, 64 (1949).

Deposition of Air-borne Particles on Trap Surfaces

STICKY traps in the form of vertical cylinders, and vertical or horizontal plates, are widely used to estimate the numbers of air-borne particles such as pollen, fungus spores, fungicides and insecticides. Although a knowledge of factors controlling deposition is a prerequisite for interpreting trap catches, the relation between the numbers deposited and their concentration in the air sweeping the surface has had scant attention. The problem has been studied here in connexion with epidemic crop diseases, and it has been shown that the size of the trap itself affects the catch to an extent greater than generally recognized.

When a plate or cylinder is placed with axis at right-angles to the wind, Sell[1], working with droplets, has shown that as the size of the trap is increased an increasing proportion of the air stream is deflected by the streamlines and fails to strike the trap. The percentage of particles deposited from the column of air sweeping the surface gives a measure of the efficiency of the trap. The concentration of particles in the air can be measured directly with a power-operated suction trap such as the Cascade impactor[2] or a bubbler device. Efficiency can be shown to depend on particle size, wind speed and dimensions of trap. In a small wind tunnel operated at speeds between 1 and 10 metres per sec., the efficiencies of vertical cylinders of various diameters have been found to agree closely with the theoretical predictions of Glauert[3]. Table 1 gives illustrative values for *Lycopodium clavatum* spores (approximately 32 μ in diameter) based on wind-tunnel and open air tests, and for spores of *Lycoperdon giganteum* (approximately 4 μ in diameter) based on a small number of open-air tests only.

Table 1. PERCENTAGE EFFICIENCY OF VERTICAL STICKY SURFACES (wind tunnel and open air tests)

		Lycopodium			*Lycoperdon*	
Wind speed (m./sec.):		1	4·25	9·75	1	4·25
Vertical cylinder	0·1 cm. dia.	73	80	80	—	—
	0·53 ,, ,,	17·5	45	58	0·07	0·3
	1·2 ,, ,,	2	25	38	0·03	0·1
Plate	0·65 ,, ,,	18	47	—	0·04	0·2
	2·54 ,, wide	1	11	23	0·007	0·004

For horizontal plane surfaces, parallel to the air flow, such as the horizontal slides standard in pollen trapping, the principles of deposition are less clear. It is generally assumed that each particle-size is deposited by sedimentation at its characteristic terminal velocity[4], the trap being 100 per cent efficient. However, wind tunnel tests, illustrated in Table 2, show that anomalous values are obtained with horizontal glass slides. At wind speeds approaching 10 metres per sec. as many *Lycopodium* spores are deposited on the under surface of a horizontal slide as on the upper. Sedimentation under gravity must therefore play a minor part except at low wind speeds, and it is suggested that deposition is brought about largely by turbulent flow over the trap surface. The number deposited is, in fact, nearly proportional to the number of spores passing over the surface in a given time, irrespective of the amount of air they are diluted with, that is, irrespective of concentration.

Table 2. No. of *Lycopodium* spores deposited per min. from a cloud concentration of 10^6 spores/m.^{3} on horizontal glass plate 3 in. × 1 in. in turbulent tunnel

Wind speed (m./sec.):	9·2	5·6	3·2	1·7	1·1
Upper surface	140	78	12	15	43
Lower surface	140	27	15	2·4	0·27

Factors controlling deposition are evidently complex and not yet well understood. While a feathery grass stigma may catch pollen with high efficiency, many types of spore trap in current use are inefficient. Deposits on surface traps give direct information only on the amount of deposition on surfaces similar to themselves in dimensions and other properties. Although the intuitive belief that there is a general positive relation between deposition on a surface and concentration in the air is correct, the trap efficiency varies with conditions, sometimes widely enough to make a direct interpretation misleading.

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May 26.

[1] Sell, W., *Forschungsheft*, **347**, 1 (1931).
[2] May, K. R., *J. Sci. Instr.*, **22**, 187 (1945).
[3] Glauert, M., Aeronautical Research Committee, *R. & M.* No. 2025. (London, H.M.S.O., 1940.)
[4] Cocke, E. C., *J. Allergy*, **9**, 458 (1938).

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, September 18—Friday, September 22

INSTITUTE OF METALS (at Bournemouth).—Forty-second Annual Autumn Meeting.

Monday, September 18

(In the School Hall, Bournemouth School for Girls, Gervis Road, Bournemouth), at 6 p.m.—Mr. E. E. Schumacher: "Communications Metallurgy".

Tuesday, September 19—Saturday, September 23

INSTITUTION OF MINING AND METALLURGY, in co-operation with the INSTITUTION OF MECHANICAL ENGINEERS, the INSTITUTION OF MINING ENGINEERS, the BRITISH IRON AND STEEL RESEARCH ASSOCIATION, and other bodies (at Ashorne Hill, Leamington Spa).—Conference on "Wire Ropes in Mines".

Wednesday, September 20—Saturday, September 23

SOCIETY FOR APPLIED BACTERIOLOGY (at the University, Nottingham).—Annual General Meeting and Conference.

ROYAL ASTRONOMICAL SOCIETY, Dublin Meeting.

Wednesday, September 20

(At the Royal Irish Academy, 19 Dawson Street, Dublin), at 6.30 p.m.—Informal Gathering of Fellows.

Thursday, September 21

(At the Royal Irish Academy, 19 Dawson Street, Dublin), at 10 a.m. and 2.30 p.m.—Astronomical Colloquium—a Discussion on "Problems of Solar Physics" (Chairman, Prof. H. B. Brück).

Friday, September 22

(At the Royal Irish Academy, 19 Dawson Street, Dublin), at 4.30 p.m.—Scientific Papers.

(In the Physics Theatre, University College, Dublin), at 8.15 p.m.—Sir Harold Spencer Jones, F.R.S.: Public Lecture on "Time".*

Saturday, September 23

(At the Royal Irish Academy, 19 Dawson Street, Dublin), at 10 a.m.—A Geophysical Discussion on "Planetary Atmospheres" (Chairman, Prof. L. W. Pollak).

Thursday, September 21

CHADWICK PUBLIC LECTURE (at St. Mary's Hospital Medical School, Norfolk Place, London, W.2), at 4.30 p.m.—Prof. J. Earle Moore (Johns Hopkins University): "The Public Health Aspects of Venereal Disease Control" (Malcolm Morris Memorial Lecture).*

Thursday, September 21—Saturday, September 23

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS AND POLYMER GROUP (in the Beveridge Hall, University of London, Malet Street, London, W.C.1).—Symposium on "Polymer Chemistry as Applied to Plastics".

Friday, September 22

OIL AND COLOUR CHEMISTS' ASSOCIATION, MANCHESTER SECTION (at the Exchange Hotel, Tithebarn Street, Liverpool), at 6.30 p.m.—Discussion on "Advantages and Disadvantages of Alkyls".

BIOCHEMICAL SOCIETY (in Derby Hall, The University, N. Mossley Hill Road, Liverpool), at 11 a.m.—Symposium on "The Biochemistry of Fish".

Friday, September 22—Monday, September 25

ASLIB (at the University, Bristol).—Annual Conference.

Saturday, September 23

BRITISH INTERPLANETARY SOCIETY, NORTH-WESTERN DISTRICT CENTRE (at the Adult Education Institute, 49 Lower Mosley Street, Manchester), at 7 p.m.—Mr. E. Burgess: "The First Moon Rocket".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT PHYSICIST in the Department of Physics Applied to Medicine—The Secretary, Barnato Joel Laboratories, Middlesex Hospital, London, W.1 (September 23).

GRADUATE ASSISTANT FOR THE BIOCHEMICAL LABORATORY—The Superintendent, Children's Hospital, Western Bank, Sheffield (September 23).

LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT—The Clerk to the Governors, Woolwich Polytechnic, Woolwich, London, S.E.18 (September 25).

CHIEF ENGINEER in the Ministry of Agriculture and Fisheries Research Vessels based on English ports—The Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3286 (September 26).

ASSISTANT TO THE DIRECTOR OF RESEARCH in the Department of the Chief Development and Research Officer—The Staff Officer (Ref. F/EV.143), London Transport Executive, 55 Broadway, London, S.W.1 (September 26).

TUTORIAL STUDENTSHIP IN PHYSICS—The Registrar, King's College, Strand, London, W.C.2 (September 27).

CHEMISTS III at Royal Ordnance Factories in Scotland, South Wales and the West of England—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.536/50A (September 30).

FISHERIES AND RIVER POLLUTION INSPECTOR to take charge of the organisation and direction of work for the prevention of river pollution, and who should possess a good knowledge of all aspects of fish biology and river management and also of the law relating to salmon and freshwater fisheries—The Acting Clerk to the Avon and Dorset River Board, 35 The Canal, Salisbury, Wilts (September 30).

HEAD OF THE SECTION OF INSECTICIDES AND FUNGICIDES at the Long Ashton Research Station—The Registrar and Secretary, The University, Bristol (September 30).

LECTURER (with special qualifications in invertebrate zoology or marine zoology or comparative physiology), and an ASSISTANT IN NATURAL HISTORY—The Secretary, The University, Aberdeen (September 30).

SENIOR SCIENTIFIC OFFICER or SCIENTIFIC OFFICER, male (Ref. C.488/50A): MECHANICAL ENGINEER having a sound knowledge of electrical engineering combined with experience in the design of light mechanical and electro-mechanical mechanisms, and a SENIOR EXPERIMENTAL OFFICER or EXPERIMENTAL OFFICER, male (Ref. C.489/50A): ENGINEER with experience in both electrical and mechanical engineering, in a Ministry of Supply Research Establishment near London—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (September 30).

LECTURESHIP IN ANATOMY—The Secretary, The University, Aberdeen (October 2).

PRINCIPAL PRODUCTION ENGINEER in the Admiralty Standards Section—The Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3284 (October 3).

JUNIOR LECTURER IN THE DEPARTMENT OF PHARMACOLOGY—The Dean, Guy's Hospital Medical School, London Bridge, London, S.E.1 (October 4).

SCIENTIFIC TECHNOLOGIST (Grade II) in the Records Section of the Scientific Department at London headquarters—The National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, endorsed TT/252 (October 4).

READERSHIP IN MATHEMATICS at Birkbeck College—The Academic Registrar, University of London, Senate House, London, W.C.1 (October 18).

PROFESSOR OF AGRICULTURAL CHEMISTRY—The Secretary and Registrar, University College of North Wales, Bangor (November 30).

AGRICULTURIST (with a University Degree in Agriculture or an equivalent diploma) for service in Yambio Agricultural Training School, Sudan—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Agriculturist, Yambio'.

ASSISTANT DRILLING ENGINEER (with a degree in Mechanical or Mining Engineering, or equivalent Institute qualifications, and with practical experience) for the Geological Survey, Sudan—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Assistant Drilling Engineer'.

ASSISTANT ENGINEER (with power plant experience) for the Sudan Gezira Board—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Sudan Gezira Board, Power Plant'.

ENGINEER-GEOLOGIST in the Public Works Department, Kenya—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting No. 27079/18/50.

HEAD OF CHEMISTRY AND BIOLOGY DEPARTMENT—The Principal, Norwood Technical College, Knight's Hill, London, S.E.27.

METEOROLOGIST, and an ASSISTANT METEOROLOGIST, Mauritius—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting No. 27118/11.

SENIOR LECTURER IN CHEMISTRY with high academic qualifications in organic chemistry—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3.

WORKS ENGINEER required by the Division of Atomic Energy (Production), Capenhurst Factory, Chester, to be responsible for all factory engineering services—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

B.I.O.S. Surveys. Report No. 24: The Pharmaceutical Industry in Germany during the Period 1939–1945. By J. B. M. Coppock. Pp. 120. (London: H.M. Stationery Office, 1950.) 3s. 6d. net. [187

London School of Hygiene and Tropical Medicine. Report of a Meeting of the Ross Institute Industrial Advisory Committee held in the Council Chamber of the Rubber Growers' Association on Tuesday, 23rd May 1950. Pp. 22. (London: London School of Hygiene and Tropical Medicine, 1950.) [247

British Society of Animal Production. Report of Proceedings of the Twelfth Meeting, held at Cambridge, August 29th–Sept. 1st, 1949. General Topic: The Livestock of East Anglia. Pp. 76. (Edinburgh: J. P. Maule, Secretary-Treasurer, King's Buildings, 1950.) 6s. [247

Department of Scientific and Industrial Research. Reports of the Forest Products Research Board, with the Reports of the Director of Forest Products Research for the Years 1939–1947. Pp. vii+94+10 plates. (London: H.M. Stationery Office, 1950.) 3s. 6d. net. [247

Air Ministry: Meteorological Office. Meteorological Reports No. 5: Aviation Meteorology of the Route Castel Benito–Cairo. Pp. ii+46. (London: H.M. Stationery Office, 1950). 1s. 6d. net. [247